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INTRODUCTION

Thousands of feet beneath the oceans' surface live creatures which few people except scientists and some fishermen have ever seen and whose existence was, until very recently, a mystery. Once thought to be lifeless, the deep ocean is now revealed to rival the rain forest in diversity of life.[1] Some studies have estimated that there could be as many as ten million species that have not yet been described and named.[2] Among the creatures of the ocean floor are many types of worms, sea anemones, sea cucumbers, clams, star fish, slugs and snails.[3] In the waters above,

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1. *See* JON ERICKSON, MARINE GEOLOGY: UNDERSEA LAND FORMS AND LIFE FORMS 60, 78 tbl.4-1 (1996). *See generally* WILLIAM J. BROAD, THE UNIVERSE BELOW: DISCOVERING THE SECRETS OF THE DEEP SEA (1997); SYLVIA A. EARLE, SEA CHANGE: A MESSAGE OF THE OCEANS (1995); GLOBAL MARINE BIOLOGICAL DIVERSITY: A STRATEGY FOR BUILDING CONSERVATION INTO DECISION MAKING (Elliott A. Norse ed., 1993) [hereinafter GLOBAL MARINE DIVERSITY]; JAMES HAMILTON-PATERSON, THE GREAT DEEP: THE SEA AND ITS THRESHOLDS 163-94 (1992); Suzanne Iudicello, *Protecting Global Marine Biodiversity*, *in* BIODIVERSITY AND THE LAW 120 (William J. Snape III ed., 1996); THE (LONDON) TIMES ATLAS AND ENCYCLOPEDIA OF THE SEA (1989); CINDY LEE VAN DOVER, THE OCTOPUS'S GARDEN: HYDROTHERMAL VENTS AND OTHER MYSTERIES OF THE DEEP SEA (1996).

2. It was not until 1992 that scientists estimated that the deep sea could harbor as many as 10 million species that have not yet been described and named. *See* GLOBAL MARINE DIVERSITY, *supra* note 1 (*citing* J. Frederick Grassle & Nancy J. Maciolek, *Deep-Sea Species Richness; Regional and Local Diversity Estimates from Quantitative Bottom Samples*, 139 AM. NATURALIST 313-41 (1992)).

3. *See* William J. Broad, *The World's Deep, Cold Sea Floors Harbor a Ri-*

still at abyssal depths, live fish, crabs, squid and shrimp, all of which are beginning to be recognized as seafood delicacies, superior to many of the existing species taken in traditional commercial fishing.[4] Some bear little resemblance to their cousins of the shallow seas. They glow in the dark, grow to enormous size, and have unusual and exotic traits which enable them to survive in a world that has no sunlight.[5] Even stranger are the sulphur-eating bacteria, tube worms, clams, mussels, and shrimp that seem to defy death by living near fiery volcanic vents in the ocean floor. These vent creatures were discovered for the first time in 1977 in the Pacific Ocean near the Galapagos Islands, and more than two hundred species, nearly all new to science, have since been found at vents on both sides of the Pacific and in the Atlantic.[6]

Part I of this Article examines the largely unknown and extremely diverse species of marine life in the world's deep seas. Part II discusses how the environmental impact on marine life caused by over-fishing, modern fishery methods, dumping, and other harmful activities threatens the existing marine diversity of the world's oceans with extinction. Part III analyzes the development of a body of law relating to coastal states' jurisdiction over the sea and surveys the current need for a separate legal regime for the marine life of the deep ocean. Finally, this Article concludes by arguing that further protection of deep sea marine life will depend on the development of the laws and policies of coastal states.

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otous Diversity of Life, N.Y. TIMES, Oct. 17, 1995, at C1.

4. *See, e.g.*, William J. Broad, *Creatures of the Deep Find Their Way to the Table*, N.Y. TIMES, Dec. 26, 1995, at C1 (on deep-sea shrimp); Leith Duncan, *Closed Competition: Fish Quotas in New Zealand*, 25 ECOLOGIST 97 (Mar./Apr., May/June, 1995) (on the orange roughy fishery of New Zealand).

5. *See* EARLE, *supra* note 1, at 119.

6. *See* GLOBAL MARINE BIODIVERSITY, *supra* note 1, at 7; VAN DOVER, *supra* note 1, at 57, 70-71, 75, 77, 108, 110, 128; Richard A. Lutz & Rachel M. Haymon, *Rebirth of a Deep-Sea Vent*, NAT'L GEOGRAPHIC, Nov. 5, 1994, at 114.

I. LIFE IN THE OCEAN DEEPS

The deep ocean floor is an exceedingly harsh environment — lightless, very cold (or, around the volcanic vents, very hot), and utterly hostile to human beings. Until the advent of underwater vehicles, it was impossible for humans, even with pressurized diving suits, to descend much beyond 1,000 feet.[7] The species under discussion were not likely to be seen in their natural habitat, but fishermen have picked up isolated specimens in a dead or dying state, and an occasional sighting of sea "monsters" has been a part of legend and fiction for centuries.[8] One of the great biological events of this century was the discovery in 1938 of a coelacanth (believed to have been extinct for millions of years) in the nets of fishermen off the Comoro Islands of the Indian Ocean.[9] Deep sea cod are now known to exist at depths of 4,600 feet, clams at 20,886 feet, and even a tiny crustacean at 36,200 feet.[10] Many of these creatures are preyed upon by animals that are thought of as normally inhabiting the upper levels of the ocean. Hammerhead sharks go to 1,500 feet and elephant seals to more than 5,000 feet in search of squid.[11] Undersea vehicles and deep-water trawling have not only enabled this marine life to be studied, but have also paved the way for its commercial exploitation.

Exploration of the deepest deeps began in 1960 with the descent of the manned bathyscaphe *Trieste* to 35,800 feet in the Challenger Deep of the Marianas Trench off Guam in the Pacific.[12] *Trieste* was never again used to explore deep ocean trenches, and this depth was not revisited for another three and

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7. For a history of attempts to reach the ocean floor, see HAMILTON-PATERSON, *supra* note 1, at 166-84. *See also* Michael D. Lemonick, *The Last Frontier*, TIME, Aug. 14, 1995, at 50, 57.

8. The poet Tennyson, for example, wrote of a legendary creature named the Kraken. *See* ALFRED, LORD TENNYSON, THE KRAKEN (1830), *reprinted in* RICHARD ELLIS, MONSTERS OF THE DEEP: THE HISTORY, NATURAL HISTORY, AND MYTHOLOGY OF THE OCEANS' MOST FANTASTIC CREATURES (1994).

9. *See* GLOBAL MARINE DIVERSITY, *supra* note 1, at 6.

10. *See* Lemonick, *supra* note 7, at 55.

11. *See* A. Peter Klimley, *Hammerhead City*, NAT. HIST., Oct. 1995, at 32, 35 (on hammerhead sharks); Brent S. Steward, *Uncommon Commuters*, NAT. HIST., Feb. 1996, at 58, 60-62 (on elephant seals).

12. *See* EARLE, *supra* note 1, at 148.

a half decades until a Japanese robot, the *Kaiko*, set a new record for deep-diving unmanned vehicles.[13] In the intervening years, manned and robot submersibles have taken part in the effort to explore the abyss at various depths and survey their inhabitants. The deepest waters will probably have to be explored by robots, for the only manned submersible to have gone beyond 21,000 feet, to date, is Japan's *Shinkai 6500*.[14] The United States robot *Alvin*, in continuous use for more than three decades, cannot go below 12,000 feet, but a small multinational fleet of submersibles is capable of operating at depths up to 20,000 feet.[15]

Oceanographers, geologists, and biologists have taken part in this research, but it is difficult and costly. Only a few of the wealthiest and most technologically advanced countries, primarily the United States and Japan, can afford to engage in it. For example, the *Kaiko*, which explored the Challenger Deep of the Marianas Trench, cost $41 million.[16] It was launched by the Japan Marine Science and Technology Center ("JAMSTEC"), whose budget is projected to grow by as much as twenty percent a year.[17] The United States, by contrast, may be forced to reduce its oceanographic programs. The institutions that operate an academic research fleet face a projected $18 million gap between operating costs and revenues by the end of this decade.[18]

Oceanic exploration, however, is not only undertaken in the cause of pure science. Much of the exploration has been a spinoff from oil and gas exploration. After one such survey for the U.S. Department of Interior's Minerals Management Service in the 1980s, scientists went on to examine marine life at depths of nearly 12,000 feet off the Atlantic Coast of the United States and found some 1500 species, most of which were previously un-

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13. *See id.* at 149; Lemonick, *supra* note 7, at 54. In 1997, Japan hopes to complete work on the world's largest oceanographic research vessel. *See* Eliot Marshall, *Japan Trolls for Global Support of Deepest Drilling Vessel*, SCI., Mar. 8, 1996, at 1358.

14. *See* EARLE, *supra* note 1, at 149.

15. *See id.* at 144, 149.

16. *See* Lemonick, *supra* note 7, at 59-60.

17. *See* Marshall, *supra* note 13, at 1358.

18. *See* Jeffrey Mervis, *A Fleet Too Good to Afford?*, SCI., Mar. 15, 1996, at 1486.

known.[19] In the United States, the University-National Oceanographic Laboratory System ("UNOLS") coordinates the use of a number of vessels owned by various agencies and institutions (including the Woods Hole Oceanographic Institute and the Moss Landing Marine Laboratories), while other agencies, such as the National Oceanic and Atmospheric Administration ("NOAA"), the Environmental Protection Agency, and the Geological Survey, operate their own ships independently of the UNOLS fleet.[20]

Some agencies have made useful maps available to the fishing industry for locating, for example, obstructions to major ocean currents, areas where fish and lobster may be abundant, and areas of volcanic activity where vent species may be found.[21] Access to technology that was originally developed for defense purposes is now granted to ocean institutions and private companies to enable them to locate and exploit resources. One such technological aid is a network of undersea microphones designed to track enemy submarines.[22] Navigation satellites and sonar enable the fishing industry to explore the oceans for replacements for the traditional fisheries that have collapsed from overexploitation.[23]

New ships and deep trawls permit huge hauls of these deep ocean fish in many parts of the world, at depths ranging from eight feet to one mile. The most sought after deep-water species include the orange roughy off the continental shelves of Australia and New Zealand, red crabs off the coast of southwest Africa, Pacific black cod and North Atlantic rattail, and royal lobster-size red shrimp off the U.S. Atlantic coast.[24] In addition, the pharma-

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19. *See* Broad, *supra* note 3, at C10.

20. *See* Mervis, *supra* note 18.

21. *See, e.g.*, DAVID T. SANDWELL & WALTER H.F. SMITH, GEOLOGICAL DATA CENTER OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY, MARINE GRAVITY ANOMALY FROM SATELLITE ALTIMETRY (1995) (wall-size map of the topography of the floor, compiled from data supplied by the U.S. Navy, the Johns Hopkins Applied Physics Laboratory, the National Oceanic and Atmospheric Administration, the European Space Agency, and the French agency PAF/IFREMER).

22. *See* William J. Broad, *Anti-Sub Seabed Grid Thrown Open to Research Uses*, N.Y. TIMES, July 2, 1996, at C1.

23. *See supra* note 21.

24. *See* Broad, *supra* note 4, at C5; Duncan, *supra* note 4, at 97.

ceutical and biotechnology industries are looking to bacteria, marine plants, and tiny animals as possible sources of miracle drugs.[25] For example, substances from marine organisms are already regarded as important for cancer research and neurobiology, and have spawned commercial ventures in Spain, Japan, Australia and the United States.[26] Companies that are financially capable of using technology to achieve a regular harvest of marine organisms could reap vast profits from new discoveries.[27]

II. THE EXPLORATION AND EXPLOITATION OF THE OCEAN'S LIVING RESOURCES

The expense of research and technology is leading both governments and industry to exploit the oceans' living resources before scientists can determine their biology, behavior, habitat and place in the marine ecosystem. For instance, only recently was anything known about the growth and reproductive rates of the orange roughy, which inhabits waters deeper than 3000 feet off the coast of New Zealand.[28] This species is now believed to live about one hundred fifty years and to spawn only after reaching thirty years of age.[29] Long before its habits were even considered, commercial fishing of orange roughy had begun, as the roughy's flesh is a prime substitute for cod, haddock, and redfish, all of whose stocks are depleted.[30] Government quotas have not only failed to protect orange roughy stock, but have actually stimulated the industry by providing security for financing deep water fleets.[31] Because the species' natural growth rate is only about one to two percent per year, the exploitation of orange roughy has almost driven the stock to the point of non-recovery.[32]

Many other deep-sea creatures mature slowly, as well. The abyssal clam, for example, is estimated to take one hundred years to

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25. *See* GLOBAL MARINE DIVERSITY, *supra* note 1, at 21-22.
26. *See id.*
27. *See id.* at 22.
28. *See* Duncan, *supra* note 4, at 99.
29. *See id.*
30. *See id.*
31. *See id.*
32. *See id.*; *see also* GLOBAL MARINE DIVERSITY, *supra* note 1, at 91.

reach a length of one-third of an inch.[33] Such slow growth renders these creatures vulnerable to extinction not only from over-fishing, but also from the side effects of modern fishery methods. Large trawlers rake the seabed several times a year in some areas, mangling nontarget species, raising clouds of suspended sediment, disrupting ecosystem processes, and preventing recolonization and recovery.[34] Although trawling causes profound disturbance of the seabed, not much research has been done on its other environmental effects.

In addition to over-fishing, ongoing oil and gas development and the projected mining of the ocean floor for manganese, titanium, and other minerals pose threats not only to marine life, but to its habitat as well. Mining debris and sediments which cover the sea floor could be a hazard for the creatures which cluster around and feed upon polymetallic nodules.[35] The NOAA is reportedly studying the impact of ocean mining on seabed living resources,[36] and it has recommended that the United Nations and all member states consider international mechanisms to protect hydrothermal vent ecosystems from such activity.[37]

Straightforward dumping — of everything from ordinary trash to sewage sludge to nuclear waste — is a problem in all the world's oceans, even at very great depths. Sewage sludge, for example, has been dumped for decades at a depth of 6,000 feet off

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33. *See* GLOBAL MARINE DIVERSITY, *supra* note 1, at 87.

34. *See id.* at 110-12; *see also* IUDICELLO, *supra* note 1, at 122; Dick Russell, *Hitting Bottom: As Trawling Goes Into High Gear, Undersea Coastal Habitat is Being Razed to the Ground*, AMICUS J. (NRDC, New York, NY), Winter 1997, at 21.

35. *See United Nations Preparatory Commission for Sea-Law Tribunal Authority, Experts on Deep Sea Marine Biology Address Special Commission 3 on Environmental Impact of Future Seabed Mining*, 165th Meeting, SEA/1328, Aug. 14, 1992, *reprinted in* 16 LAW OF THE SEA: DOCUMENTS 1983-1994, ser. 2, at 25, 27 (Renate Platzoeder ed., 1994). The biggest reserves of polymetallic nodules lie on the seabed of the north Pacific (manganese), the East Pacific (iron, copper and zinc), and the Red Sea between Sudan and Saudi Arabia (zinc, copper, silver and gold). *See* ERICKSON, *supra* note 1, at 24.

36. *See* William J. Broad, *Plan to Carve Up Ocean Floor Riches Nears Fruition*, N.Y. TIMES, Mar. 29, 1994, at B5.

37. *See* GLOBAL MARINE DIVERSITY, *supra* note 1, at 291.

the coast of New Jersey on the edge of the continental slope.[38] Vessel-generated refuse is a major source of marine litter. Israeli trawlers researching deep sea life in the Mediterranean found that seventy percent of their trawls contained solid waste (as compared to fifty-seven percent in the Gulf of Alaska and forty-one percent in the Bering Sea).[39] They found that plastic sheeting was particularly disruptive to abyssal life because it prevents food from filtering down to the seabed.[40]

Another serious problem is the ocean disposal of radioactive wastes and other hazardous materials, some of which have been buried in the ocean deep for as long as half a century. Between 1946 and 1970, radioactive material was dumped off the mid-Atlantic coast of the United States at depths ranging from 6,000 to 12,000 feet.[41] In 1970, the U.S. Navy deliberately sank a vessel containing nerve gas in 16,000 feet of water some 280 miles east of Florida.[42] Russia has a long history of radioactive dumping in the Arctic Ocean, the Sea of Japan, the Barents Sea, and the Kara Sea.[43] Much of this was from nuclear submarines, but as recently as 1993, it was reported that a Russian tanker had released 900 tons of liquid nuclear waste into the Sea of Japan.[44] Several west European countries have dumped low-level radioactive waste into the ocean and reserve the right to resume the practice in the future.[45] Very little has been attempted to determine what

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38. *See* VAN DOVER, *supra* note 1, at 159-60, 164-67.

39. *See Survey Finds Flagrant Violations of Curbs on Mediterranean Sea Dumping*, 19 Int'l Env't Rep. (BNA) 444 (1996).

40. *See id.*

41. *See* Daniel P. Finn, *Ocean Disposal of Radioactive Wastes: The Obligation of International Cooperation to Protect the Marine Environment*, 21 VA. J. INT'L L. 621 (1981).

42. *See* Norman G. Letalik, *Pollution from Dumping, in* THE ENVIRONMENTAL LAW OF THE SEA, 217, 218 (Douglas M. Johnston ed., 1981).

43. *See* Kristin Moody-O'Grady, *Nuclear Waste Dumping in the Oceans: Has the Cold War Taught Us Anything?*, 35 NAT. RESOURCES J. 695, 697 (1995).

44. *See id.* at 698.

45. *See* Robert K. Temple, *Regulation of Nuclear Waste and Reactor Safety Within the Commonwealth of Independent States: Toward a Workable Model*, 69 CHI.-KENT L. REV. 1071, 1078 (1994).

impact such activity might have on the abyssal marine environment.

Least known of all, perhaps, is the way in which deep ocean species interact with each other and with other forms of marine life, or how entire food chains and ecosystems can be endangered. Marine biologists are only beginning to trace predator-prey relationships in the deep waters. They discovered that the giant squid, for instance, feeds on the orange roughy and is in turn preyed upon by hammerhead sharks and elephant seals.[46] However, this knowledge is still not nearly sufficient; as one scientist declared, "we know more about Mars than we know about the oceans."[47] This is so at least in part due to the fact that, until very recently, the focus of biodiversity research has been centered on land ecosystems, especially the tropical forests.[48] The United Nations Convention on Biological Diversity in 1992[49] did not deal specifically with the preservation of marine biological variability beyond a requirement that, with respect to the marine environment, parties implement the convention consistently with the rights and obligations of states under the law of the sea.[50] However, at their second meeting the parties agreed that an expert group should be created to protect marine biological diversity,[51] and requested the undertaking of a study of the conservation and sustainable use of genetic resources on the deep seabed.[52]

One thing is apparent from the research undertaken to date. Many of these deep ocean creatures in all their remarkable diversity exist in quite small populations at individual sites and are regionally distinct (particularly sea floor species). In this, they re-

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46. *See* Broad, *supra* note 4, at C5; Klimley, *supra* note 11, at 36; Steward, *supra* note 11, at 63.

47. *See* Lemonick, *supra* note 7, at 54.

48. *See* Kal Raustiala & David G. Victor, *Biodiversity Since Rio: The Future of the Convention on Biological Diversity*, 38 ENV'T 17, 19 (1996).

49. *See* Convention on Biological Diversity, 14th Conference of the Parties, Second Meeting, Jakarta, November 6-17, 1995, *reprinted in* 26 ENVTL. POL'Y & L. 121 (1996).

50. *See id.*

51. *See id.*

52. *See id.* at 123 (Decision II/10, para. 12).

semble the fauna of islands, the difference being that these are islands under the sea, not islands in the sea. They share at least some of the characteristics of island biogeography (a field only recently developed in biological science).[53] The most important characteristic is that the smaller the island, the more vulnerable its species are to extinction by any agency, especially human interference.[54] The "territories" of even the most sedentary species in no way conform to human lines drawn in the ocean or on the seabed. Marine life of the deep waters and ocean floor is under actual or potential attack from many quarters — the fishing industry worldwide, the pharmaceutical and biotechnological industries, and the oil and minerals industries. Technologically advanced nations are gearing up to stake claims to explore and exploit this unique resource. Does the sea need a legal regime of its own, or is the existing law of the sea capable of protecting it from harm?

III. THE DEEP SEA AND THE LAW

A. *The Scope of Protection*

In the past, the bottom of the oceans outside the territorial sea was considered *res nullius* or *res communis* and, therefore, outside the jurisdiction of any state.[55] In any case, the bottom of the sea and its denizens were of little practical interest to states because of the lack of technical means to exploit them. This changed in the 1940s when oil deposits were found in shallow coastal seas and the means to exploit them began to develop.[56] From then on, the status of the ocean floor became of practical

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53. On island biogeography — the study of the distribution of species on islands and island-like fragments of ecosystems — there is already a considerable literature. For a comprehensive bibliography and up-to-date survey of the subject, *See* DAVID QUAMMEN, THE SONG OF THE DODO: ISLAND BIOGEOGRAPHY IN AN AGE OF EXTINCTIONS (1996).

54. *See id.* at 256.

55. *See* 1 D.P. O'CONNELL, THE INTERNATIONAL LAW OF THE SEA 449-50 (1982).

56. *See* Treaty Relating to the Submarine Area of the Gulf of Paria, Feb. 26, 1942, Gr. Brit.-Venez., 205 L.N.T.S. 121-27.

interest. The United States took the initiative, and, in the Truman Proclamation of 1945,[57] asserted jurisdiction over the natural resources of the subsoil and the seabed of the continental shelf beneath the high seas contiguous to the U.S. coast. The United States based its claim on the security requirements of coastal states and on the worldwide need for new sources of petroleum, which could best be satisfied by coastal states whose continental shelves must be regarded as an extension of the land mass. No claim was made as to jurisdiction over the waters above the continental shelf, which were to remain high seas. A White House press release of September 28, 1945, the same date as the Truman Proclamation, clarified the U.S. claim as generally extending seaward to a depth of 600 feet (100 fathoms).[58] Leading scholars began to regard coastal state jurisdiction over the resources of the continental shelf as part of the customary law of the sea, leading to its eventual incorporation in treaty law.[59]

In 1958, the Geneva Convention on the Continental Shelf granted states sovereign rights over the exploitation of mineral resources of the sea bottom adjacent to their shores.[60] Under the Convention, coastal states acquired exclusive jurisdiction over the exploitation of minerals and sedentary species on or in the continental shelf,[61] but the waters over the shelf were still governed by the principle of freedom of the seas.[62] The Convention left the exact definition of the continental shelf itself, however, open-ended, making it dependent on the state of technology. The continental shelf was deemed to extend as far as the 200-meter isobath, or beyond that whenever technology permitted exploitation at greater depths.[63] At that time, it was thought that a depth of 200 meters was about the limit of feasible exploitation.[64] While

57. *See* Proclamation No. 2667, 3 C.F.R. 67 (1943-1948).

58. *See* 13 DEPT. ST. BULL., Sept. 28, 1945, at 483-85.

59. *See* 4 MARJORIE M. WHITEMAN, DIGEST OF INTERNATIONAL LAW 751-52 (1965).

60. Convention on the Continental Shelf, Apr. 29, 1958, T.I.A.S. No. 5578, 499 U.N.T.S. 311.

61. *See id.* art. 2.

62. *See id.* art. 3.

63. *See id.* art. 1.

64. *See* D.W. BOWETT, THE LAW OF THE SEA 34 (1967).

the Convention on the Continental Shelf left deep-sea sedentary species outside the jurisdiction of coastal states, the trend toward a seaward extension of jurisdiction became irresistible.[65]

The LOS Convention introduced the concept of the continental margin, which comprises the continental shelf as well as the continental slope and the continental rise.[66] It gave jurisdiction over minerals and living sedentary organisms of the continental margin to the coastal state to a distance of 350 miles outward from the baseline from which the territorial sea is measured, or to the 2500 meter (8,250 foot) isobath, that is, to a line joining points where the depth of the ocean is 2,500 meters.[67] The Convention also introduced the concept of the Exclusive Economic Zone ("EEZ"), extending 200 miles from the baseline.[68] Within this zone, the coastal state acquired jurisdiction over free-swimming organisms at any depth,[69] and an exclusive jurisdiction over sedentary fisheries, regardless of depth or presence of a continental margin.[70]

As far as free-swimming organisms are concerned, the Convention imposes a duty of conservation. This duty is based on objective, though vague, criteria such as: maximum sustainable yield, fishing patterns, interdependence of stocks, generally recommended minimum standards, and the maintenance and restoration of associated or dependent species above levels at which their reproduction may become seriously threatened.[71] This may

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65. *See* O'CONNELL, *supra* note 55, at 492-503.

66. United Nations Convention on the Law of the Sea, Dec. 10, 1982, S. TREATY DOC. NO. 103-39, 21 I.L.M. 1261 [hereinafter LOS Convention]. The continental slope and the continental rise are extensions seaward and downward of the continental shelf, the slope being steeper and the rise rare gentle. *See* 1 E.D. BROWN, THE INTERNATIONAL LAW OF THE SEA 265-67 (1994); GARY KNIGHT & HUNGDAH CHIU, THE INTERNATIONAL LAW OF THE SEA: CASES, DOCUMENTS, AND READINGS 399-400, 402 fig. (1991).

67. *See* LOS Convention, *supra* note 66, art. 76, para. 5.

68. *See id.* art. 57.

69. *See id.* art. 56, para. 1.

70. *See id.* art. 56, para. 3. Jurisdiction over the continental margin may extend to 350 miles from the baseline or 100 miles beyond the 2,500 meter isobath. *See id.* art. 76, para. 5 & art. 77.

71. *See id.* art. 61, paras. 3, 4.

imply that the coastal state can extend some protection to deep-sea sedentary organisms. However, the conservation measures are not enforceable, since any dispute as to their adequacy can only be brought before a conciliation commission whose findings are not binding.[72] Thus, the fate of both sedentary and deep-sea free-swimming organisms within the EEZ depends entirely on the laws and policies of the coastal states. That discretion does exist outside the EEZ, but only for sedentary species when the continental margin extends to specified distances beyond the EEZ.[73] Coastal state power over the fate of deep-sea species becomes evident when the extent of ocean over which archipelagic states have jurisdiction is taken into consideration. The EEZ of archipelagic states extends 200 miles outward from the straight lines linking the outermost islands of an archipelago.[74] This EEZ is added to the archipelagic waters, that is, waters enclosed by straight baselines linking the outer islands over which archipelagic states have full sovereignty.[75]

The coastal state also controls any research in its EEZ and on its continental shelf. No research can be undertaken without its consent.[76] In normal circumstances, the coastal state has the duty to grant consent for marine scientific research carried on by other states or competent international organizations.[77] At its discretion, however, it can withhold consent if the project is of direct significance for the exploration and exploitation of natural resources, living or non-living[78] — with the exception of research on the continental shelf beyond 200 nautical miles.[79]

B. *High Seas Fisheries*

Beyond the EEZ, according to the LOS Convention, fisheries are open to all states on condition that they cooperate in the conservation and management of living resources of the high

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72. *See id.* art. 297, para. 3b.
73. *See id.* art. 76, para. 5 & art. 77, para. 4.
74. *See id.* art. 48.
75. *See id.* art. 47, paras. 1-9.
76. *See id.* art. 56, para. 1b(III) & art. 246, para. 2.
77. *See id.* art. 246, paras. 3, 4.
78. *See id.* para. 5a.
79. *See id.* para. 6.

seas.[80] This cooperation is to be effected through appropriate agreements which would establish subregional or regional fisheries organizations. States have concluded high seas fisheries agreements as far back as the middle of the 19th century.[81] The early instruments had little or no interest in the conservation of the resource. In time, however, as fishing became more intensive, agreements began to lay stress on the need for conservation and the commissions they created were charged with the study of conservation measures.[82] Conservation measures, however, were handicapped by insufficient knowledge and ongoing conflicts between coastal and distant fishing states. This made cooperation precarious and contributed to the instability of fishing agreements.[83]

The United States tried to mitigate this inherent conflict by propagating special, but not exclusive, rights of coastal states in adjacent stretches of the high seas. In the Truman Proclamation,[84] the United States, as a coastal state, claimed the right to unilaterally establish conservation zones in areas of the high seas contiguous to its coasts in which its nationals alone could fish. In areas in which nationals of other countries also fished, conservation zones should be established by agreement.[85] Although no such zones resulted, the Truman Proclamation influenced the 1958 Convention on Fishing and Conservation of the Living Resources of the High Seas,[86] which also reserved special rights to coastal states in the area of the high seas adjacent to their territorial waters.[87] The Convention had little effect on the conserva-

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80. *See id.* arts. 116-118.

81. *See* Ludwik A. Teclaff, *Jurisdiction Over Offshore Fisheries: How Far Into The High Seas?*, 35 FORDHAM L. REV. 409, 411 (1967).

82. *See id.* at 411; DOUGLAS M. JOHNSTON, THE INTERNATIONAL LAW OF FISHERIES 325-26 (1965); O'CONNELL, *supra* note 55, at 524-27.

83. *See* G.R. Munro, *Extended Jurisdiction and the Management of Pacific Highly Migratory Species*, 21 OCEAN DEVEL. & INT'L L. 291, 292-95 (1990).

84. Proclamation No. 2668, 3 C.F.R. 68 (1943-1948), *reprinted in* 59 Stat. 885-86.

85. *See id.*

86. Convention on Fishing and Conservation of the Living Resources of the High Seas, Apr. 29, 1958, 17 U.S.T. 138, 559 U.N.T.S. 285.

87. *See id.* arts. 6, 7.

tion of living resources of the oceans,[88] however, like the Truman Proclamation, it reinforced tendencies to expand coastal jurisdiction which may not be fully satisfied even by the LOS Convention's establishment of the EEZ.[89]

The shrinking of the high seas was a slow process that began when coastal states excluded other coastal states from offshore fisheries by claiming a larger-than-three miles territorial sea.[90] By the time the 1930 Conference for the Codification of International Law was convened, claims to a territorial sea ranged from three to eighteen miles.[91] The International Court of Justice, in the Anglo-Norwegian dispute in 1951, dealt with the baselines for measuring the territorial sea,[92] but some of the individual opinions of the judges acknowledged the lack of agreement among states on the width of the territorial sea. Judge Alvarez stated in his opinion that, because of the great variety of geographic and economic conditions of states, it was not possible to lay down uniform rules governing the extent of territorial waters.[93] Consequently, in its 1956 report to the U.N. General Assembly, the International Law Commission was only able to state that it was not against international law to claim a width of territorial sea up to 12 miles from shore.[94]

Both the 1958 and the 1961 conferences on the Law of the Sea failed to agree on the width of the territorial sea and coastal state fisheries.[95] By then the gap between the concept of territorial sea and that of coastal fisheries was well established, and the protection and conservation of the resources from overfishing by fishing fleets were reasons advanced for claiming jurisdiction

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88. *See* Teclaff, *supra* note 81, at 416.

89. *See* LOS Convention, *supra* note 66, art. 55; *see also* Joyner & De Cola, *Chile's Presential Sea Proposals for Straddling Stocks and International Fisheries*, 24 OCEAN DEVEL. & INT'L L. 99 (1993); B. Kwiatkowska, *Creeping Jurisdiction Beyond 200 Miles*, 22 OCEAN DEVEL. & INT'L L. 153 (1991).

90. *See* O'CONNELL, *supra* note 55, at 135-138.

91. *See id.* at 159 n.233.

92. *See Anglo-Norwegian Fisheries Case*, 1951 I.C.J. 116.

93. *See id.* at 145.

94. [1956] 1 Y.B. Int'l L. Comm'n 180; *see also* O'CONNELL, *supra* note 55, at 161-62.

95. *See* Teclaff, *supra* note 81, at 419.

over extended offshore fisheries.[96] The final divorce of the two concepts and the victory of proponents of extended offshore fisheries came in the LOS Convention, which established a twelve-mile territorial sea and a 200-mile fishery zone.[97] In the case of anadromous and catadromous stocks, the Convention even extended the jurisdiction of the coastal state beyond the 200-mile limit.[98]

This shrinking of the high seas did not prevent overfishing both in and beyond the EEZ.[99] Despite a growing understanding of the problem, improvements in conservation measures have been hampered and outpaced by improvements in fishing methods and fishing gear. Immense nets strewn between ships miles apart are denuding vast reaches of the ocean of all life to great depths in the effort to catch one particular type of fish.[100] Overfishing and the threat to species other than the target ones are deadly side effects of progress and increased technical efficiency. Under the prodding of the United States, New Zealand, and Australia, the U.N. General Assembly voted moratoria on the driftnets used to catch tuna and squid, which are particularly devastating for dolphins that swim with the tuna schools.[101] On its own initiative, the United States enacted dolphin protection legislation,[102] and a treaty has been concluded on driftnet fish-

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96. *See id.* at 420-21; *see also* O'CONNELL, *supra* note 55, at 532-36.

97. *See* LOS Convention, *supra* note 66, arts. 3, 57.

98. *See id.* arts. 66, 67; *see also*, William T. Burke, *Anadromous Species and the International Law of the Sea*, 22 OCEAN DEVEL. & INT'L L. 95.

99. *See Canada-Spain Dispute about Fisheries in the North Atlantic*, AMICUS J. (NRDC, New York, NY), Fall 1995, at 21.

100. *See* Evelyne Meltzer, *Global Overview of Straddling & Highly Migratory Fish Stocks: The Nonsustainable Nature of High Seas Fisheries*, 25 OCEAN DEVEL. & INT'L L. 255, 261-62 (1994).

101. G.A. Res. 44/225, U.N. GAOR 2d Comm., 44th Sess., Agenda Item 82(f), U.N. Doc. A/RES/44/225 (1989). This resolution was reaffirmed on Dec. 21, 1990. G.A. Res. 45/197, U.N. GAOR 2d Comm., 45th Sess., Agenda Item 79, U.N. Doc. A/RES/45/197 (1991).

102. *See* Diana Hurwitz, *Fishing for Compromises Through NAFTA and Environmental Dispute Settlement: The Tuna-Dolphin Controversy*, 35 NAT. RESOURCES J. 501 (1995). *See, e.g.*, High Seas Driftnet Fisheries Enforcement Act of 1992, Pub. L. 102-582, 106 Stat. 4909 (codified as amended in scattered sections of 16 U.S.C.); International Conservation Act of 1992, Pub. L. 102-523, 106 Stat. 3432 (codified as amended in scattered

ing.[103] Such measures, especially the moratoria, if followed in coastal state fishing zones may provide a breathing space for threatened species, including the creatures of the great deeps.

Highly migratory species and species which straddled the boundaries between states' EEZs continued to cause problems. The inability of the existing network of international agreements and national measures to stem worldwide depletion of fishery stocks led the U.N. General Assembly to take action. In December 1992, the U.N. General Assembly passed a resolution to convene an intergovernmental conference on straddling and highly migratory fish stocks to meet in New York in July 1993.[104] One difficulty was that, despite the fairly clear provisions of the LOS Convention, the United States refused to concede coastal state jurisdiction to unilaterally control tuna fishing in the EEZ, on the ground that effective management of highly migratory stocks could not be provided by a coastal state alone.[105] The United States' attitude clashed with the long-established policies of Latin America and contributed to the instability of fishing arrangements in the seas bordering South America.[106] However, the United States was losing the battle and was forced to retreat from its position due to the success of Pacific Island states in managing fisheries in their huge archipelagic EEZs.[107]

The changed attitude of the United States helped to fulfill the mandate of the General Assembly and, after two years of negotiations, the Convention on Straddling and Highly Migratory Spe-

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sections of 16 U.S.C.).

103. *See* Convention for the Prohibition of Fishing With Long Driftnets in the South Pacific, Nov. 24, 1989, 29 I.L.M. 1449.

104. G.A. Res. 47/192, U.N. GAOR 2d Comm., 47th Sess., Agenda Item 79, at 29, U.N. Doc. A/47/719 (1992).

105. *See* Michael K. Orbach & John R. Maiolo, *United States Tuna Policy: A Critical Assessment*, 1 MARINE POL'Y REP. 307, 317-18 (1989); *see also* Christopher M. Welb, *Critical Evaluation of Existing Mechanisms for Managing Highly Migratory Pelagic Species in the Atlantic Ocean*, 20 OCEAN DEVEL. & INT'L L. 285, 287-89 (1989).

106. *See* Munro, *supra* note 83, at 294-95. *See also* Edward L. Males & William T. Burke, *Pressures on the United Nations Convention on the Law of the Sea of 1982 Arising From New Fisheries Conflicts; The Problem of Straddling Stocks*, 20 OCEAN DEVEL. & INT'L L. 343, 347 (1989).

107. *See* Munro, *supra* note 83, at 296-301.

cies was signed in 1995.[108] In an attempt to reverse the creeping extension of individual coastal state jurisdiction, the Convention introduced a scheme which attempted to synchronize conservation measures and make them compatible within and outside the EEZ.[109] On paper, the adopted measures seem potentially effective, but the tendency in previous agreements to sanction overfishing through generous quotas is a reminder that division of the spoils, so prominent in the early fishery treaties, is hard to resist and exercise.

C. *The Effects of Pollution*

Equally threatening to the living resources of the oceans, if not more so, is pollution and destruction of habitat. The danger of pollution was first perceived when ocean-going ships switched from coal to oil as fuel.[110] Efforts to remedy the threat began with the abortive Washington Conference on Oil Pollution in 1926[111] and resulted in three different responses. First, the Convention of 1954, with its amendments, endeavored to limit operational discharges of oil from ships.[112] Then the 1969 Civil Liabil-

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108. Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of 10 December 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, *opened for signature* Dec. 4, 1995, 34 I.L.M. 1542.

109. *See id.* art. 7.

110. *See generally,* Ludwik A. Teclaff, *Beyond Restoration: The Case of Ecocide,* 34 NAT. RESOURCES J. 933, 939-44 (1994) (discussing oil pollution of the oceans).

111. Final Act of the Preliminary Conference on Oil Pollution of Navigable Waters, June 8-16, 1926, T.S. NO. 736-A, *reprinted in* U.S. DEP'T OF STATE, PUB. NO. 1646, 1 FOREIGN RELATIONS OF THE U.S., 1926, at 238 (1941); *see also* Joseph C. Sweeney, *Oil Pollution of the Oceans,* 37 FORDHAM L. REV. 155, 188 (1968).

112. Prevention of Pollution of the Sea by Oil: Amendments to the Convention of 1954, Oct. 21, 1969, 28 U.S.T. 1205; Prevention of Pollution of the Sea by Oil, Apr. 4-11, 1962, 17 U.S.T. 1523 1600 U.N.T.S. 332; International Convention for the Prevention of Pollution of the Sea by Oil, *opened for signature* May 12, 1954, 12 U.S.T. 2989 1327 U.N.T.S. 3.

ity Convention,[113] radically recodified in 1992,[114] dealt with compensation for accidental spills of oil. Finally, the so-called MARPOL 73/78 Convention was aimed at preventing oil pollution through ship construction and operational standards.[115] The LOS Convention, in contrast to the 1958 Convention on the High Seas,[116] deals more extensively with pollution from vessels and considerably enhances the enforcement power of the coastal state, even for spills outside coastal state jurisdictional zones.[117] However, in spite of considerable improvement in preventive measures, oil pollution remains a major threat to the living resources of the oceans. Even species that live in very deep waters or on the seabed are at risk because oil spills interfere with the food chain by preventing food supplies from descending through the water column.[118]

Radioactive materials are potentially even more deadly because they remain active for a very long time. The danger of nuclear contamination from ships and onshore installations was dealt with by the law of the sea not unlike the manner in which oil pollution from ships was dealt with. The 1962 Nuclear Ships Convention assigned absolute liability for pollution to the operator of the nuclear ship and required the operator to carry financial security to cover his liability.[119] The Nuclear Damage Conven-

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113. International Convention on Civil Liability for Oil Pollution Damage, Nov. 29, 1969, 9 I.L.M. 45.

114. 1992 Protocol to the 1969 Convention on Civil Liability for Oil Pollution Damage, Nov. 27, 1992, [1 Reference File] Int'l Env't Rep. (BNA) §21, at 1551.

115. MARPOL 73/78 is comprised of the International Convention for the Prevention of Pollution from Ships, Nov. 2, 1973, 12 I.L.M. 1319, and the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, Feb. 16, 1978, 17 I.L.M. 546.

116. The 1958 Convention on the High Seas had only one article on oil pollution. Convention on the High Seas, *done* Apr. 29, 1958, art. 24, 2 U.S.T. 2312, 450 U.N.T.S. 82.

117. *See* LOS Convention, *supra* note 66, art. 211.

118. Food supply to the seafloor must be completely generated in the upper layers of the water column. Anything that inhibits surface photosynthesis has a direct impact on bottom dwellers. *See* VAN DOVER, *supra* note 1, at 16.

119. Convention on the Liability of Operators of Nuclear Ships, May 25, 1962, art. II, 57 AM. J. INT'L L. 268, 269 (1963).

tion of 1963 makes the operator of nuclear installations liable for damage caused by nuclear incidents occurring in the installation or by those originating in the installation and occurring elsewhere.[120] These conventions are inadequate to protect the environment since they come into operation, like the civil liability oil pollution conventions, only after the damage has been done. Dumping, as such, was considered not prohibited by international law unless it unreasonably affected other uses of the sea.[121]

These measures are not enough. A more effective remedy is the outright prohibition on dumping of high-level radioactive waste and some toxic substances achieved by the London Dumping Convention ("LDC") of 1972.[122] While the LDC explicitly prohibits the dumping of highly toxic material listed on a so-called black list, it originally did not prohibit dumping altogether; other wastes, including low-level radioactive material, could be dumped under a state permit.[123] At the ninth consultative meeting, in 1985, a resolution was adopted whereby it was agreed that all dumping of radioactive waste, low-level included, must be suspended until studies were completed.[124] The Convention only dealt with deliberate dumping and leaves open the question of storing radioactive waste of any level in the seabed, which is still considered the most acceptable solution for the intractable problem of nuclear waste disposal.[125] No matter how well encased the waste might be, however, its burial in the seabed would present a perennial threat to the deep sea and seabed environment.[126]

The LOS Convention provides a framework treaty for control of marine pollution.[127] It does not prohibit such pollution, but

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120. Vienna Convention on Civil Liability for Nuclear Damage, May 21, 1963, art. 4, para. 1, 1063 U.N.T.S. 265, 269.

121. *See* Ludwik A. Teclaff, *International Law and the Protection of the Oceans from Pollution*, 40 FORDHAM L. REV. 529, 530-31 (1972).

122. *See* Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, 26 U.S.T. 2403, 1046 U.N.T.S. 120.

123. *See id.* art. 4.

124. *See* BROWN, *supra* note 66, at 367-68.

125. *See id.* at 367.

126. *See id.*

127. *See* LOS convention, *supra* note 66, §§ 4, 5 (Monitoring and

charges states with assessment, prevention, reduction, and control, as the case may be, repeating these requirements for every kind of marine pollution. Like the LDC, it provides for reexamination of measures as circumstances require. Article 210, on dumping, specifically states that: "States acting especially through competent international organizations or diplomatic conference, shall endeavor to establish global and regional rules, standards, and recommended practices and procedures to prevent, reduce and control such pollution. Such rules, standards and recommended practices and procedures shall be examined from time to time as necessary."[128]

The species that live on the bed of the high seas are not only endangered by indiscriminate dumping, but also, and perhaps even more so, by the side effects of exploration and exploitation of their habitat for minerals that lie on or are embedded in the bottom of the sea. Until the LOS Convention of 1982, the bed of the high seas was considered *res nullius* and, therefore, open to appropriation.[129] By declaring the bed of the high seas the common heritage of mankind,[130] the LOS Convention internationalized the seabed and, at the same time, created an elaborate regime for the exploitation of seabed minerals.[131] In 1994, the United States agreed to a protocol which met U.S. objections and safeguarded the interest of the most industrially developed states, which alone have the capability to undertake exploitation of seabed minerals.[132] Although this international regime is geared toward mining, the Authority which administers it for the benefit of mankind is charged with adopting appropriate rules, regulations, and procedures for the protection and conservation of natural resources and the prevention of damage to the flora

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Environmental Assessment; International Rules and National Legislation to Prevent, Reduce and Control Pollution of the Marine Environment).

128. *See id.* art. 210, para. 4.

129. *See* O'CONNELL, *supra* note 55, 449-50.

130. *See* LOS Convention, *supra* note 66, art. 136.

131. *See id.* pt. XI (The Area).

132. Agreement Relating to the Implementation of Part XI of the United Nations Convention of the Law of the Sea, With Annex, July 29, 1994, S. TREATY DOC. NO. 103-39.

and fauna of the marine environment.[133] Thus, if the Authority wants to exercise it, they have the power to protect species that live on the seabed. The Convention also requires those states which undertake exploration on the bed of the high seas to prevent, reduce and control pollution of the marine environment from their operations.[134]

D. *The Future of Ocean Regulations*

As of this writing, there is no separate legal regime, no individual agreement pertaining to the marine life of the deep ocean and its habitat. Even the all-embracing United Nations Convention on the Law of the Sea of 1982 makes no mention of this unique biota, because it was drawn up at a time when abyssal forms of life were not yet widely known or considered important. Nevertheless, this framework convention, its predecessor conventions, and the many special agreements drawn up in recent years do provide a body of law whose provisions could be applied specifically to the protection of deep-ocean biodiversity. Within the past half century (even longer in some instances), the traditional idea of "freedom of the seas" has steadily whittled away with respect to marine living and non-living resources and the marine environment.

The main burden in conservation and management under the LOS Convention rests with the coastal state and, as noted above, it is precisely within coastal states' jurisdiction that many of the deep sea ecosystems, and threatened species lie.[135] Coastal states have two primary responsibilities which, in the case of living resources of the really deep waters and ocean trenches, may seriously conflict. The first responsibility is to ensure, through

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133. *See* LOS Convention, *supra* note 66, art. 145.

134. *See id.* art. 209.

135. Most of the world's deepest ocean trenches are along island arcs in the Pacific, such as the Aleutian and Kurile Islands, and the islands of Japan, the Philippines, Indonesia, the New Hebrides, and Tonga. Other notable deeps are the Peru-Chile, Middle America, and Puerto Rico trenches, all within EEZS. off eastern North America, canyons with wall heights of 3,000 feet or more (in the case of the Great Bahamas Canyon, 14,000 feet) carve through the continental margin. *See* ERICKSON, *supra* note 1, at 60, 78 tbl.4-1.

proper conservation and management measures and taking into account the best scientific evidence available, that the living resources of the EEZ are not endangered by over-exploitation. The second major responsibility is to maintain or restore the maximum sustainable yield of these resources. The problem is that, in the case of abyssal creatures with geographically distinct populations, slow growth, and slow reproductive rates, coastal states may never know what constitutes over-exploitation until a species is already extinct.

The sheer remoteness and difficulty of access have saved these creatures so far, and it is uncertain whether many of them should be exploited at all. Attempts to set a maximum sustainable yield in one instance — the orange roughy — failed, because the best scientific evidence available was inadequate and misleading.[136] Many coastal states are in no position, financially or technologically, to obtain such evidence. In the absence of this kind of scientific evidence coastal states have no incentive to establish a safe permissible catch in the interests of conservation, whether for themselves or for foreign nations with access to the resource. Unless and until some future specific agreement, resembling the 1995 Convention on Straddling and Highly Migratory Species, introduces a comprehensive scheme of conservation, division of the spoils by quota or similar arrangement will probably remain the basis of management.

The combined efforts of states and international organizations are needed to give priority to research, to exchange information, to assess the potential effects of planned activities in deep waters, to identify problems, and to establish guidelines — all of which will take time. In this policy and management vacuum, the single most important decision that states can make is to adopt either the precautionary principle or approach.[137] The precautionary principle is the more stringent form of the doctrine, requiring regulatory prohibition; the approach is more flexible and appears as a guide to policy. This doctrine, in whichever form, re-

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136. *See* Duncan, *supra* note 4, at 97-99.

137. For its application to the marine environment, see John M. Macdonald, *Appreciating the Precautionary Principle as an Ethical Evolution in Ocean Management*, 26 OCEAN DEVEL. & INT'L L. 255 (1995).

quires that an activity posing a threat to the environment be prevented from causing harm even if there is no conclusive scientific proof linking such activity to environmental damage. It is applicable to many kinds of threat to the environment and has already evolved from a pollution control doctrine (its earliest application) into a fisheries management tool. Its effects are twofold. It shifts the burden of proof onto the party making any proposal that will affect the marine ecosystem, and it serves as an incentive to states to pursue more environmentally friendly technology and management regimes.

The precautionary principle is implicit, for example, in the evolution of international dumping policies over the past quarter of a century. High-level radioactive waste dumping has been prohibited, the dumping of industrial waste is being phased out, and the freedom of states to dump in the EEZs of other states is now limited by consent requirements.[138] Explicitly, the doctrine has been adopted by a number of international bodies, from the 1987 Second International Conference on the Protection of the North Sea[139] to the 1992 UNCED Conference in Rio.[140] It is evident in fisheries management, for example, in the United Nations high seas driftnet ban of 1989.[141] Most recently, the United Nations Agreement of 1995 on Straddling Fish Stocks and Highly Migratory Fish Stocks makes explicit reference to the precautionary approach, devoting an article and an annex to measures for its application.[142] Also in 1995, the *Marine* Environment Protection Committee of the International Maritime Organization ("IMO") adopted guidelines on the precautionary approach which it aims to submit for use throughout the organization.[143]

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138. See BROWN, *supra* note 66, at 366-71, on the evolution of dumping policy under the LDC. *See also supra* notes 122-26 and accompanying text.

139. Second International Conference on the Protection of the North Sea, Ministerial Declaration, London, Nov. 25, 1987, 27 I.L.M. 825, 838.

140. Rio Declaration on Environment and Development, *adopted* June 14, 1992, 31 I.L.M. 874.

141. *See supra* note 94.

142. *See* United Nations Agreement on Straddling and Highly Migratory Fish Stocks, *supra* note 99, art. 6 & Annex II.

143. *See* IMO, Report of the 37th Session of the Marine Environ-

CONCLUSION

Through moratoria on exploitation, through bans on trawling similar to the driftnet ban, through permanent prohibitions on seabed disposal of hazardous waste, and other implementations of the precautionary principle in advance of adequate scientific information, it may be possible to gain a little time and protect the marine ecosystems of the deep oceans from the consequences of human disruption for short-term profit. In the long run, however, there is need for a specific agreement on abyssal species and their habitat, covering the existing gaps in the law of the sea.

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ment Protection Committee, September 11-15, 1995, Guidelines on the Application of the Precautionary Approach, *in* 26 ENVTL. POL'Y & L. 16 (1996).