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International Environmental Law: Turning the Tide on Marine Pollution

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INTERNATIONAL ENVIRONMENTAL LAW: TURNING THE TIDE ON MARINE POLLUTION

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> [A]nd a third of the sea became blood, a third of the living creatures in the sea died, and a third of the ships were destroyed . . . . A third of the waters became wormwood, and many died of water, because it was made bitter.

Revelation 8:9,11

I. INTRODUCTION

Seventy-one percent of the earth's surface is dominated by the oceans. Their majesty and immensity have long been a source of great wonder and veneration. Before the age of discovery, mankind believed that the oceans extended to infinity. Even today, the collective world view of the vastness of the oceans has influenced how we treat the oceans as a receptacle for our waste products.[1] The oceans embody the largest segment of the environment which mankind can, and in fact does, directly influence.[2] The oceans have been a natural receptacle for the refuse of the globe long before the existence of man and they will continue to be so, long after man's demise. To draw a disturbing metaphor, the oceans are presently the ultimate dumping ground for virtually all of the by-products of man's activities.[3]

Two opposing schools of thought have emerged concerning the use of the oceans for waste disposal. One school urges that the oceans should be used for waste disposal. This school contends that the ocean has a virtually limitless assimilative capacity and, therefore, can accommodate tremendous amounts of waste without causing damage.[4] A second school, however, views the oceans as our "last bastion of defense," and believes that careful control of waste disposal is necessary.[5] These conservationists recognize that the oceans produce seventy to eighty percent of the world's oxygen and contain approximately eighty percent of the planet's animal and plant life.[6]

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1. *See* H. NEAL & J. SCHUBEL, SOLID WASTE MANAGEMENT AND THE ENVIRONMENT—THE MOUNTING GARBAGE AND TRASH CRISIS 65 (1987) [hereinafter NEAL & SCHUBEL].

2. J. KINDT, MARINE POLLUTION AND THE LAW OF THE SEA 5 (1986).

3. Knauss, *Ocean Pollution: Status and Prognostication*, in LAW OF THE SEA: THE EMERGING REGIME OF THE OCEANS 322 (1973).

4. *See* Waldichuk, *An International Perspective on Global Marine Pollution*, in IMPACT OF MARINE POLLUTION ON SAFETY 68 (V. Tippie & D. Kester eds. 1982).

5. *Id.* at 68-69; *see also Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), The Health of The Oceans*, U.N. Environment Programme (Regional Seas Reports and Studies No. 16) 4, 6-7 [hereinafter GESAMP].

6. Larson, *Foreword* to 11 OCEAN DEV. & INT'L L.J. 2 (1982).

Since the 1960s, the conservationists have warned the rest of society that many ecosystems do not exhibit a gradual degradation, but rather demonstrate an ability to maintain the basic integrity of their systems up to the point of their collapse.[7] The conservationists cite the seemingly sudden demise of large inland water systems, such as Lake Erie, to substantiate their view of nature's ability to deceive man.[8] Until Lake Erie's sudden collapse, warnings about its deterioration were disregarded for years due to favorable water quality reports. By the time of the collapse, an injunction against the perpetrators of this irreparable degradation process was no longer feasible.[9] Accordingly, conservationists urge that to prevent an ocean wasteland, the warnings of the late 1960s must be acted upon today. Moreover, they contend that the oceans have a finite capacity to receive large amounts of contaminants, and that the "health" of the oceans must to some degree hinge on whether or not this capacity is being approached.[10] The notion of environmental capacity suggests that a threshold level for contaminants exists which must not be exceeded.[11]

As the world's population multiplies and industry expands, the problem of man's degradation of the environment becomes more critical and compelling. Marine pollution, in particular, represents one of the most significant of the environmental problems facing man. As populations move to the coast, seeking its amenities and myriad recreational and commercial opportunities, the increasing and often conflicting social and economic demands of modern life exert substantial pressure on limited and fragile resources.[12] With the abundant use of sea lanes for commerce and the increasing size of cargo tankers, the threat to the marine environment posed by accidental and intentional discharge of noxious substances becomes more ominous daily.[13] Most pollutants reach the oceans through the rivers, by run-off from the land or by fallout from the atmosphere.[14]

Vessel-generated pollution, however, also contributes to the

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7. Falk, *Toward a World Order Respectful of the Global Ecosystem*, 1 ENVTL. AFF. 251, 252 (1971).
8. *Id.*
9. *Id.*
10. GESAMP, *supra* note 5, at 89.
11. *Id.*
12. MARINE POLLUTION AND SEA LIFE at v (Mario Ruivo ed. 1972) [hereinafter Ruivo].
13. *Id.*
14. *Id.*

cumulative impact of waste absorbed by the oceans.[15] Two examples are the shipwreck of the *Argo Merchant* off the coast of Massachusetts in 1976, which spewed 27,000 tons of oil into the Atlantic, and the devastating grounding of the *Torrey Canyon* off Cornwall, England in 1967, which deposited thirty-five million gallons of oil along a hundred miles of British and French beaches, shocked the world.[16] While such catastrophic accidents are trumpeted by the media, a much larger quantity of oil and other pollutants is being discharged annually from routine operation of commercial and military vessels.[17] The trend has been to devote our attention and research dollars to oil spills, dredge spoil disposal or toxic waste disposal. However, insufficient attention has been paid to the most pervasive influx of pollutants in coastal waters, namely, ordinary sewage.[18] The incidence of vessel-generated pollution by substances other than oil has not been the subject of systematic study.

This article is limited to an inquiry into the nature and scope of those pollution problems in the United States and abroad that are caused by the operational, incidental discharge of sewage and solid wastes into the marine environment. The article will discuss the impact of sewage and solid waste disposal on the marine environment and on human health and welfare. It will evaluate domestic and international regulation of vessel-source pollution and focus on some of the major multilateral treaties, including the United Nations Convention on the Law of the Sea ("UNCLOS III"). The discussion will conclude with proposals for the establishment of an institution for data collection and monitoring of known contaminants, in order to permit more reasoned decisionmaking about the uses of the oceans.

II. The Nature of Pollution: Ingredients for the Degradation of the Marine Environment

The world's rivers annually transport three to four billion tons of material from the land to the oceans, where it commingles with

15. *See infra* Part II, sec. A and accompanying notes.

16. *See* Cycon, *Calming Troubled Waters: The Developing International Regime to Control Operational Pollution*, 13 J. Mar. L. & Com. 35, 35 (1981).

17. *Id.*

18. Schneider, *Foreword* to *Chronic Pollution: A Case Study of the Southern California Bight*, in Impact of Marine Pollution on Society 214 (V. Tippie & D. Kester eds. 1982).

the water.[19] In addition, material from the land is blown into the ocean.[20] This transport of material from land to ocean has been uninterrupted since early geological times. The ocean is the final reservoir for all materials, whether blown by air currents or transported by the rivers. The composition of seawater mirrors the balance between the rate at which material enters the ocean and the speed within which it is eventually lodged on the ocean floor.[21] Despite the length of time of this continuous process, authorities are reasonably confident that there has been no significant alteration in the composition of seawater for tens of thousands of years, and probably not for millions of years.[22]

The Intergovernmental Oceanographic Commission has provided a widely accepted definition of marine pollution: "Marine pollution is the introduction by man, directly or indirectly, of substances or energy into the marine environment, resulting in such deleterious effects as: harm to living resources; hazards to human health; hindrance to marine activities including fishing; impairing the quality . . . use of seawater; and reduction of amenities."[23] Underlying the definition of pollution is the presumption that pollution is a process created and virtually controlled by mankind and human activities.

Through man's activities, pollution usually enters the ocean in one of four ways. Pollution can enter the ocean through man-built outfalls through which effluents from sewage treatment plants pass directly into the ocean.[24] The atmosphere is another route through which a surprisingly large amount of material, including mercury, lead, and DDT, reaches the ocean from the land.[25] Of all the routes, this is the most difficult to monitor and trace to its source.[26] A third route is via rivers and estuaries. Natural materials as well as pollutants added to the rivers and estuaries from land

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19. Knauss, *supra* note 3, at 314.

20. For example, Sahara Desert sands have been found in air samples collected in the Caribbean. *Id.*

21. *Id.* at 314-15. The process is much more complex than presented here. A more complete discussion, however, is beyond the scope of this article.

22. J. RILEY & R. CHESTER, INTRODUCTION TO MARINE CHEMISTRY 61 (1971).

23. *See* S. GERLACH, MARINE POLLUTION DIAGNOSIS AND THERAPY 4 (1981); Springer, *Towards a Meaningful Concept of Pollution in International Law*, 26 INT'L & COMP. L.Q. 531 (1977).

24. Examples of these outfalls are the sewer outfalls of San Diego and Long Beach, California. *See* Knauss, *supra* note 3, at 317.

25. *Id.*

26. *Id.*

drainage, sewers, and dumping, can be traced many miles from the shore.[27] The fourth way in which pollutants arrive at the ocean is by man's maritime activities. These activities include intentional ocean dumping and vessel pollution generated during the normal course of navigation.[28] Although large oil-tanker spills have a cataclysmic impact on the marine environment, vessel source pollution could prove to be the most easily monitored and regulated source of marine pollution.

Some sources of pollution lend themselves more readily to expedient and effective regulation while others are more difficult to control. Despite the fact that the oceans have an enormous assimilative capacity, it remains imperative to protect the oceans against pollution. If the oceans become polluted, it is not an easy task to clean them. One cannot clean the oceans as easily as a bay or lake. Unlike the oceans, if a pond, river or lake falls prey to pollution, it can be rehabilitated in a relatively short time.

Thus, it appears that a correlation exists between the size of the water body and the residence time.[29] While the ocean's ability to assimilate degradable matter is impressive, once foreign material reaches the ocean it remains there forever. Consequently, adequately recording input[30] and systematic surveying of environmental levels of contamination are necessary.[31] Absent such understanding, the injury inflicted upon the environment or upon mankind cannot be accurately assessed. A firm scientific basis for control of vessel-generated sewage pollution does not yet exist. There is a paucity of reliable data about the overall inputs and even less data concerning its biological effects on man and the environment.[32] Overall, then, sewage is a virtually uncontrolled waste which constantly invades the marine environment and has effects which remain scientifically unexamined.

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27. *Id.*

28. Cycon, *supra* note 16, at 35-36.

29. Residence time (*i.e.*, the time it takes for a body of water to cleanse itself) is equal to the volume of water in a lake, estuary or other body of water divided by the rate of flow into and out of that body of water. For example, the residence time for Lake Erie, one of our most polluted major lakes, is 2½ years. *See* Knauss, *supra* note 3, at 321. When residence time is applied to the oceans, the time scale greatly increases. For instance, the residence time for the Mediterranean Sea is 50 to 100 years. *Id.* at 322.

30. GESAMP, *supra* note 5, at 66.

31. *Id.* at 66.

32. Boehmer-Christiansen, *The Scientific Basis of Marine Pollution Control*, 6 MARINE POL'Y 2 (1982).

A. *Ships, Sewage and Sea Life*

In 1675, New York Governor Edmond Andros forbade all persons "to cast any dung, dirt or refuse of ye city, or anything to full ye harbor or among ye neighbors or neighboring shores under penalty of forty shillings."[33] Since the governor's pronouncement, the quantity and variety of pollutants dumped into the oceans have magnified tremendously, and now include industrial wastes, dredged material, and sewage sludge.[34] In 1970, a government agency described the situation:

> Shellfish have been found to contain hepatitis, polio virus, and other pathogens. Pollution has closed at least one-fifth of the nation's commercial shellfish beds; beaches and bays have been closed to swimming and other recreational use; lifeless zones have been created in the marine environment; there have been heavy kills of fish and other organisms; and identifiable portions of the marine ecosystem have profoundly changed.[35]

Thus, marine pollution had substantially degraded the environment in the United States.

Still one is left to question why marine pollution is so common in the United States. Notably, the United States has over 100,000 miles of coastline.[36] In excess of 46,000 federally registered commercial vessels, 65,000 unregistered commercial fishing vessels, 2,000 federally owned vessels and 4.5 million recreational watercraft sail these waters.[37] The potential sewage pollution from these vessels has been estimated to be equal to the pollution generated by the population of a city the size of San Diego.[38] Most observers regard vessel-generated marine pollution to be insignificant as a total source of pollution; however, it can be a serious obstacle to achieving clean water in some harbors and recreational areas.[39]

A severe example of marine degradation is the 1979 study of

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33. S. REP. NO. 451, 92d Cong., 1st Sess. 9, *reprinted in* 1972 U.S. CODE CONG. & ADMIN. NEWS 4234, 4236, *cited in* Lahey, *Ocean Dumping of Sewage Sludge: The Tide Turns from Protection to Management*, 6 HARV. ENVTL. L. REV. 395 (1983).

34. A. REED, OCEAN WASTE DISPOSAL PRACTICES 8-11 (1975).

35. U.S. COUNCIL ON ENVIRONMENTAL QUALITY, A NATIONAL POLICY 12-18 (1970).

36. J. KINDT, *supra* note 2, at 7.

37. F. GRAD, ENVIRONMENTAL LAW SOURCES AND PROBLEMS § 2.01, at 2-13 (1971); NEAL & SCHUBEL, *supra* note 1, at 67.

38. F. GRAD, *supra* note 37.

39. *Id.* at 2-20.

pollution in the Mediterranean Sea.[40] The waters of the Mediterranean receive an estimated one billion tons of household and untreated wastes and a half of a million tons of intentional operational discharge annually. Furthermore, experts estimate that the one hundred million tourists in thousands of pleasure boats each year generate more pollution than the aggregate created by ships and tankers.[41] What makes this situation disturbing is the pollution's residence time is such that the Mediterranean is able to cleanse itself only once every ninety years.[42] The 1979 study indicates that although vessel-generated pollution is not the main source of pollution in the Mediterranean, it is partially responsible for the degradation of the waters. Other parts of the globe replicate this trend.

Although many observers regard vessel-generated sewage pollution as insignificant when evaluating the overall incidence of marine pollution, the disposal of sewage waste at sea poses numerous environmental problems. Acknowledging the limited scope of this inquiry, the effect of sewage on the marine environment is summarized below.

Sewage contains nutrients such as nitrogen and phosphorus.[43] In turn, these nutrients induce massive growths of algae and other phytoplankton.[44] By ingesting the dissolved oxygen contained in the water, these growths suffocate marine life in a process known as "eutrophication."[45] Although inland waters are characteristically more vulnerable to injury than are ocean waters, coastal areas also suffer from oxygen demand problems as a consequence of slower flushing rates and chronic oxygen depletion.[46] Blooms of phytoplankton and the development of red tides are other problems posed by nutrient overload. These blooms are of such intensity that the sea becomes discolored. The blooms are not always red but may be yellow or brown as well. Red tides exclude valuable

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40. J. KINDT, *supra* note 2, at 6.

41. *Id.*

42. *Id.*

43. D. ROSS, INTRODUCTION TO OCEANOGRAPHY 329 (2d ed. 1977).

44. *Id.* at 329-30.

45. "Eutrophication" is a process that occurs when a body of water has accumulated an abundance of nutrients that stimulate a heavy growth of plant and animal life, the decay of which depletes the shallow waters of oxygen in warm weather. Note, *The Ocean Dumping Dilemma*, 10 LAW. AM. 868, 875 n.27 (1978).

46. NAT'L ADVISORY COMM. OCEANS & ATMOSPHERE, THE ROLE OF THE OCEAN IN A WASTE MANAGEMENT STRATEGY 60 (1981) [hereinafter NACOA REPORT].

commercial fish from the affected area.[47] In addition, some species of phytoplankton that grow when exposed to excess nutrients are toxic to marine and human populations. For instance, shellfish exhibit a tendency to "bioconcentrate"[48] these toxic substances that have entered the food chain. When humans eat these contaminated shellfish the results can be disastrous.[49] The discharge of sewage in the marine environment may have additional harmful effects on human health. Visible sewage debris on beaches and coastal shallow waters may exude an offensive odor and greatly impair natural aesthetics, but more important, may menace human health. Sewage contains pathogenic bacteria viruses and parasites that reflect the range of diseases which are present in the human population.[50] These organisms can live, sometimes for days, in the seas. Viruses can survive even longer than bacteria, especially when they become fixed to bottom organisms.[51]

In areas of the world which lack adequate drainage and plumbing systems, feces may be deposited directly on the beach, thus creating inevitable dangers of infection. Recent studies indicate that bathing in sewage-contaminated water can result in disease, particularly in areas where the endemic enteric disease rate is high.[52] Moreover, the consumption of fish and shellfish harvested from sewage-contaminated water can cause bacterial and viral enteric infections.[53] For instance, the New York Bight Apex, the coastal waters adjacent to the New York Harbor, has been dubbed the most severely degraded coastal area in the world. The highly polluted environment has caused gill clotting, tumors, and fin rot in fish, which have, in turn, adversely affected commercially important marine species. Furthermore, bacterial contamination has compelled the Food and Drug Administration to prohibit shellfishing in most of the area.[54]

Where sewage is discharged into the ocean during the course of vessel navigational operations, the effects will depend on the

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47. R. CLARK, MARINE POLLUTION 20 (1986).

48. "Bioconcentration" is a process by which substances enter aquatic organisms through the gills or integument directly from solutions in the water. NACOA REPORT, *supra* note 46, at 67.

49. *Id.* at 61.

50. GESAMP, *supra* note 5, at 40.

51. *Id.*

52. *Id.*

53. *See supra* note 35 and accompanying text.

54. H.R. REP. No. 200, 98th Cong., 1st Sess. 9 (1983).

rate and volume of the discharge and, more important, on the characteristics of the area in which the sewage is discharged.[55] Some experts suggest that in areas where material is rapidly dispersed by water movements and does not collect on the bottom, long-term effects are not discernible.[56] For example, scientists have closely examined ocean dumping of sewage sludge, which releases not only organic material and nutrients, but also potentially toxic metals and organohalogens. In some cases, scientists have not detected these toxins in dumping grounds. The main changes are believed to be attributed to organic enrichment resulting in "species-poor but often biomass-rich benthic communities." However, where decomposition of organic material results in anoxic conditions on the bottom and waters above, the benthic macrofauna may be diminished to a few resilient species of worms.[57] The most important economic impact occurs when the habitat becomes unsuitable for benthic organisms of commercial importance.[58]

Since the organic constituents of sewage are largely degradable, it is not regarded as a long-term contaminant if its introduction into the sea is adequately managed.[59] Thus, evidence suggests that given the proper controls, it is possible to dispose of sewage in the ocean in a manner which does not pose a threat to the marine environment. At present, problems are "local rather than global, and coastal rather than oceanic."[60] Although effects of sewage pollution have not yet been discovered on a global scale, general trends of increasing contamination can be recognized in some regions. Increased contamination, noticeable primarily in areas most intensively used by mankind (*i.e.*, coastal waters), should serve as a warning sign of impending environmental harm, and should merit further scientific examination.[61]

B. A Sea of Plastics

The ocean disposal of solid waste also requires further scientific examination. For the past decade conservationists, scientists, commercial fishermen and others have become increasingly con-

55. GESAMP, *supra* note 5, at 40.
56. *Id.*
57. *Id.*
58. *See supra* notes 35 & 53 and accompanying text.
59. GESAMP, *supra* note 5, at 40.
60. *Id.* at 41.
61. *Id.* at 45.

cerned with the noticeable increase in the volume of debris present in the world's oceans. For example, during his 5,000 mile voyage on the *Kontiki* in 1947, Thor Heyerdahl observed virtually no indication of man's impact on the oceans, and no signs of pollution.[62] Nevertheless, in a similar voyage twenty years later, Heyerdahl encountered numerous signs of man including oil slicks, pieces of glass and plastic containers,[63] on forty-three out of the fifty-seven days.

Solid waste has been defined to include all "material which is normally solid, and which arises from animal or human life and activities and is discarded as useless or unwanted."[64] In 1979, the United States alone generated 130 million metric tons of municipal refuse, five million metric tons of dry weight sewage sludge, 430 million metric tons of dry weight agricultural wastes, more than three billion tons of mining wastes, and in excess of 344 million tons of industrial wastes.[65]

The United States has the dubious distinction of producing more garbage and trash than any other nation in the world. In 1980, the average person generated nearly 1200 pounds of solid waste for the year. The volume of waste produced in the United States has risen dramatically over the past three decades and, according to predictions, will continue to increase. By 1995, the population of the United States is predicted to increase to roughly 260 million. Projections indicate that the production of municipal solid wastes will increase even more rapidly than the population.[66]

How do these pollutants reach the sea? The great majority of these solid wastes are transported to the oceans through the atmosphere and by rivers.[67] Pollution generated by shipping, however, is an additional and significant source of contamination.[68] According to Lloyd's of London, roughly 71,000 merchant ships were in

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62. Utton, *Managing the International Environment*, 16 NAT. RESOURCES J. 597, 597 (1976).

63. *Id.* (citing Paterson, *Marine Pollution and the Law of the Sea*, 1975 BULL. ATOMIC SCIENTISTS 49).

64. A. REED, *supra* note 34, at 183.

65. Wolf, *Public Opposition to Hazardous Waste Sites: The Self-Defeating Approach to National Hazardous Waste Control Under Subtitle C of the Resource Conservation and Recovery Act of 1976*, 8 B.C. ENVTL. AFF. L. REV. 463, 466 (1980).

66. NEAL & SCHUBEL, *supra* note 1, at 2.

67. Utton, *supra* note 62.

68. *Id.*

operation in 1979.[69] Human beings on passenger ships alone produce 28,000 tons of garbage per annum.[70] Merchant marine crews and pleasure craft passengers are estimated to contribute 110,000 tons and 103,000 tons of garbage per annum, respectively.[71]

In essence, virtually all of the garbage and trash from the globe's commercial fleet is jettisoned directly into the ocean.[72] The National Academy of Sciences estimates that the trash discarded into the world's oceans, is categorized as follows: 1) paper materials - sixty-three percent; 2) metal - 16.6 percent; 3) glass - 9.6 percent; plastic - 0.7 percent; and 5) rubber - 0.5 percent.[73] Although plastics comprise only a small fraction of solid waste thrown into the oceans, their harmful impact on the environment and seeming omnipresence make them an appropriate focus of this discussion.[74] It has been estimated that 639,000 plastic containers are discarded daily into the sea.[75] This estimation assumes that an average of thirty people per ship, and 9,000 ships are operating at any one time. However, these estimates do not include Navy vessels, which may accommodate 5,000 people per carrier. Also absent from these figures are the trash and garbage generated from numerous pleasure craft, oil tankers, and research vessels.[76] In a 1973 study, E.L. Venrick observed in his direct samplings up to thirty-five million plastic bottles on the surface of the North Pacific.[77]

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69. Wallace, *Debris Entanglement in the Marine Environment: A Review*, in PROCEEDINGS OF THE WORKSHOP ON THE FATE AND IMPACT OF MARINE DEBRIS 259, 260 (NOAA Tech. Memo 1985) [hereinafter NOAA REPORT].

70. S. GERLACH, *supra* note 23, at 69.

71. *Id.*

72. NEAL & SCHUBEL, *supra* note 1, at 67. If any treatment of trash and garbage is undertaken, it is only to compact it, and this is done only in a small percentage of vessels. *Id.*

73. *Id.* The fact that boaters produce less garbage and trash per capita may be attributed to an absence of daily newspaper delivery and conservative purchase practices mandated by limitations aboard ship. *Id.*

74. Plastics appear everywhere, averaging 3,500 pieces per square kilometer as reported in the Sargasso Sea in 1971 by Carpenter & Smith, *Plastics on the Sargasso Sea*, 175 SCIENCE 1240-41 (1972). The ocean concentration of plastics in surface waters ranged from 1 to 10 ounces per square nautical mile. *See* Colton, *Plastics in the Ocean*, 18 OCEANUS 61-64 (1974).

75. *See* Dixon, *Tackling U.K. Shoreline Refuse*, 9 MARINE POLLUT. BULL. 91 (1978); Horsman, *The Amount of Garbage Pollution from Merchant Ships*, 13 MARINE POLLUT. BULL. 167, 168 (1982); Colton, Knapp & Burns, *Plastic Particles in Surface Waters of the Northwestern Atlantic*, 185 SCIENCE 491 (1974).

76. NOAA REPORT, *supra* note 69, at 261.

77. Venrick, Backman, Bartram, Platt, Thornhill & Yates, *Man-Made Objects on the Surface of the North Central Pacific Ocean*, 241 NATURE 271 (1973) [hereinafter Venrick].

Although coastal factories are the major source of plastics deposited in the ocean,[78] routine solid waste disposal by individual vessels during their normal course of operation greatly contributes to land-based sources of pollution.[79] Studies have indicated that an abundance of small "raw" polyethylene pellets from intermediary processes in the plastics industry have been found in sediments in rivers and estuaries downstream from factories.[80] These raw polyethylene pellets, at times moved in bulk like grain, are also shipped around the world to be used in the packaging of larger objects carried in ships' holds.[81] The pellets are also commonly used upon the decks of vessels to reduce the friction from the movement of large objects.[82] Many of these pellets are washed from the decks and are dispersed through the world's oceans by wind and atmospheric currents. Also, as a result of improper loading, stowage, and unloading, plastics make their escape to the sea.[83] For example, studies in Scotland confirm that most of the litter washed ashore comes primarily from shipping and not from local industry or local inhabitants.[84] The prevalence of plastics in the oceans has adversely impacted birds,[85] fish,[86] marine mammals,[87] sea turtles,[88] and even humans.[89] Entangling debris and

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78. *Id.*

79. *See* Merrell, *A Decade of Change in Nets and Plastic Litter from Fisheries Off Alaska*, 15 MARINE POLLUT. BULL. 378, 379 (1984); *see generally* NOAA REPORT, *supra* note 69, at 260-62.

80. *Id.* at 261-63.

81. Day, Wehle & Coleman, *Ingestion of Plastic Pollutants by Marine Birds*, in PROCEEDINGS OF THE WORKSHOP ON THE FATE AND IMPACT OF MARINE DEBRIS 344, 376 (NOAA Tech. Memo 1985).

82. *Id.* at 377.

83. *Id.* at 376-77.

84. Scott, *The Growth of Plastics Packaging Litter*, 7 INT'L J. ENVTL. STUD. 131, 132 (1975).

85. Birds are affected by four types of debris: large pieces of netting which cause their immediate drowning; trash and net fragments which entrap their heads and extremities; monofilament and string which wrap around their feet, wings and beak; and particles which are ingested. *See* Rothstein, *Plastic Particle Pollution of the Surface of the Atlantic Ocean: Evidence from a Sea Bird*, 75 CONDOR 344-45 (1973); Wehle & Coleman, *Plastics at Sea*, 92 NAT. HIST. 20, 20-26 (1983).

86. *See* Carpenter & Smith, *supra* note 74.

87. *See* NOAA REPORT, *supra* note 69, at 268-69. Among the most intelligent, extraordinary, and, unfortunately, vulnerable of the globe's creatures are the marine mammals. The fate of these animals is inescapably dependent upon man's use of the marine environment. It has been estimated that, on the whole, marine life has declined by 40% during the past few decades. Levin, *Toward Effective Cetacean Protection*, 12 NAT. RESOURCES LAW. 549, 550 (1979).

88. *See* Wehle & Coleman, *supra* note 85.

89. *See* NOAA REPORT, *supra* note 69, at 270.

plastics, in particular, have existed in the marine environment since the beginning of manufacturing plastics on a large scale.[90] Fish also suffer from ingestion of plastic particles and netting. Manta rays have been recorded as having had their wings sliced through by monofilament lines and a large number of fish have drowned in ghost nets.[91] Despite this disturbing state of affairs, there has been a lack of research and documentation in this area.

Marine mammals succumb to entanglement in at least three different ways. Large fragments weighing about ten pounds can kill a Northern fur seal. Entanglement in medium size fragments may result in exhaustion and starvation. The energy level for swimming, breathing, and catching food becomes insufficient to sustain the animal. Finally, small fragments may suffocate the animal slowly over a period of time as the animal's body grows into the debris.[92] The Northern fur seals have suffered an estimated 50,000 debris entanglement-related deaths per year.[93] Sea turtles, especially the leatherbacks, have mistaken plastic bags for jellyfish. Ingestion of plastic bags has resulted in intestinal blockage and ultimately the death of these turtles. Young turtles often mistake styrofoam for their chief diet of small crustaceans.[94]

Although ghost nets caught in boat propellers during violent storms have caused some loss of human lives,[95] the greatest impact of plastic debris on mankind is in commercial losses.[96] The tearing of trawl nets on bottom debris costs fishermen great sums of money. The floating debris' interference with ships' propellers, shafts, screws, and water intake results in sizeable economic loss. In American ports in 1969, the total loss to shipping from floating debris was about 17.5 million dollars.[97]

Floating debris washing up on the shoreline beaches has also resulted in considerable economic loss. In 1976, Long Island beaches were befouled by floating debris which was cleared up at a cost of $100,000. The cost to beach-related industry was between fifteen and twenty-five million dollars.[98] Bermuda, for example,

90. Venrick, *supra* note 77.
91. NOAA REPORT, *supra* note 69, at 268.
92. *Id.* at 268-69.
93. *See* Wehle & Coleman, *supra* note 85, at 24.
94. NOAA REPORT, *supra* note 69, at 269-70.
95. *Id.* at 270.
96. *Id.* at 270-71.
97. NEAL & SCHUBEL, *supra* note 1, at 70.
98. *Id.*

spends more than $100,000 annually to remove tar balls and plastic debris from less than two miles of public beach.[99]

Entire local communities whose industries revolve around sea birds are affected economically by this situation as well. Birdwatching brings many shore areas considerable revenue. For example, the tiny, remote St. Paul and St. George Islands Aleutian communities generate hundreds of thousands of dollars each year from bird watchers.[100] Birdwatching constitutes one of the main commercial sources of income in these communities.[101] Consequently, a loss of their bird populations would have devastating economic and social effects.

In addition to the economic costs of pollution, there are cultural and aesthetic costs, which are difficult to measure. Nonetheless, there is a cost, "often paid by those not responsible for the debris, but it lowers everyone's benefits and expectations for benefits in the future."[102]

While the literature is replete with evidence of harm caused to marine life, some commentators maintain that beneficial uses are to be derived from solid wastes. One thesis is that solid wastes serve to provide an artificial substrate or habitat for fish.[103] Because of their abundance, durability, and low cost, automotive tires have been used for the construction of artificial reefs, islands, and floating breakwaters.[104] However, in the absence of empirical studies, such uses of waste have been considered too risky and unpracticable due to the high cost of implementing such ideas.[105]

C. The Domestic Regulation of Vessel-Generated Pollution

As a source of ocean pollution, vessels would seem amenable

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99. *Id.*

100. NOAA REPORT, *supra* note 69, at 271.

101. *Id.*

102. *Id.*

103. A. REED, *supra* note 34, at 37.

104. *Id.*

105. NEAL & SCHUBEL, *supra* note 1, at 78. Once the amount of waste and its composition have been determined, decision-makers should consider resource recovery as part of the solution to the ocean pollution problem. "Resource recovery" means "any materials separation and/or conversion of solid waste for the purpose of recovering materials or energy products." S. RUSSELL, RESOURCE RECOVERY ECONOMICS 7 (1982). There needs to be an assessment of the types of energy and material products to determine their marketability and potential markets need to be investigated. Revenue generated from resource recovery can be used for pollution control. *See generally id.*

to regulation. Yet the discharge of sewage, trash, and garbage generated by shipping has virtually slipped through the loopholes of pollution controls and has escaped direct regulation. Scarce financial resources are an important consideration which affects decisionmaking regarding vessel-generated waste management. Once again, inadequate research has been undertaken to investigate the ocean's response to vessel-generated waste disposal.

Water pollution prevention legislation has failed to address or consider, as a pollution source, vessel-generated sewage and solid waste disposal in the oceans. The earliest pollution prevention legislation came closest to regulating vessel-generated sewage and solid waste pollution. The Rivers and Harbors Act of 1899, commonly known as The Refuse Act,[106] made it unlawful to "throw, discharge, or deposit or cause, suffer, or procure to be thrown, discharged, or deposited either from or out of any ship, barge, or other floating craft of any kind, any refuse matter of any kind or description whatever. . . ."[107]

The Rivers and Harbors Act of 1899 has been largely supplanted by the Federal Water Pollution Control Act,[108] which regulates continuous discharges into internal and marine waters. However, vessel-generated sewage and solid wastes are outside of the Act's purview, insofar as these pollutants are not within the definition of "point sources."[109] This source of pollution also falls outside of the scope of the Marine Protection, Research, and Sanctuaries Act,[110] which established a regulatory framework designed to abate pollution caused by unrestrained dumping. Under Section 1402 of the Act, "dumping" does not mean "the routine discharge of effluent incidental to the propulsion of, or operation of motor-driven equipment on, vessels . . . ."[111] Although the Coast Guard has regulations that control the discharge of raw sewage within territorial waters through the use of prescribed marine sanitation devices, these regulations are generally not enforced.[112]

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106. The Rivers and Harbors Act of 1899, ch. 425, § 13, 30 Stat. 1152, *amended by* 33 U.S.C. §§ 401-415 (1982).

107. 33 U.S.C. § 407 (1982).

108. 62 Stat. 1155 (1948), *amended by* 33 U.S.C. §§ 1251-1376 (1982).

109. For a discussion of the many shortcomings of the Federal Water Pollution Control Act and an analysis of its interrelationship with the River and Harbor Act of 1899, see Note, *The Refuse Act: Its Role Within the Scheme of the Federal Water Quality Legislation*, 46 N.Y.U. L. REV. 304, 319-23 (1971).

110. Pub. L. No. 92-532, § 2, 86 Stat. 1052, *amended by* 33 U.S.C. §§ 1401-1445 (1982).

111. 33 U.S.C. § 1402 (1982).

112. Reasons given for the failure of the Coast Guard to enforce its own regulations on

D. Pollution in the North Sea

In 1967, the International Council for the Exploration of the Sea ("ICES") conducted a study for the purposes of collecting factual data on pollution reaching the North Sea. Additionally, the ICES analyzed the national legislation regulating the discharge or dumping of wastes into the sea and the associated research on the progress of neighboring countries.[113] This action by the ICES coincided with an increase in concern over the effects of pollution on the marine environment. Although the ICES was primarily interested in the environmental impact caused by accidental oil spills, many other long-term and short-term pollutants were included in the study. The report disclosed that very large amounts of sewage (much of it untreated) reach the North Sea. Although most of the sewage discharge is generated from land-based sources in coastal towns, vessel-source pollution should always be considered in pollution management programs.

What is more, oil pollution is regarded as a constant threat in the North Sea because of the high concentration of shipping at the entrances to the major European ports, in the Thames Estuary and the Straits of Dover.[114] Vessel-generated sewage and garbage pollution should also be a threat in this area as a result of intensive shipping activities. The discharge of sewage and garbage at sea in such a relatively shallow area as the North Sea needs to be controlled according to the same principles as are employed in coastal and river areas where residence time is generally slow.[115]

E. Pollution in the Baltic Sea

Recently more countries have become concerned with pollution in the open sea.[116] Large intracontinental or land-locked seas are very vulnerable to pollution because of long shorelines and restricted water exchange. Countries bordering on the Baltic Sea have been cognizant of coastal pollution problems. Indeed, the Bal-

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marine sanitation devices include a shortage of manpower and more pressing enforcement priorities, such as drug enforcement and boating safety. Interview with Lt. Commander Edward L. Ristaino, Office of the Chief Counsel, United States Coast Guard, in Miami, Florida (Apr. 12, 1988).

113. *See* 1969 ICES REP., POLLUTION OF THE NORTH SEA 61.

114. *Id.* at 7.

115. *See supra* note 29 and accompanying text.

116. *See* 1970 ICES REP., POLLUTION OF THE BALTIC SEA 86.

tic Sea ranks among the most polluted seas in the world.[117] The Baltic is surrounded by seven industrialized countries with dense populations and suffers from a very restricted water exchange with the open ocean via the North Sea.[118]

More than twenty million people travel by ship every year between Sweden and Denmark. Some 500 passenger craft navigate the Baltic Sea every summer, and there are daily ferry tours across the Baltic. From this traffic, the ICES Group estimated that between 250 to 400 m^3 of rubbish is dumped into the sea every day. As a result, fishing trawlers have removed themselves from the area around ferry routes in order to avoid clogging of their trawls with discharged beer cans, bottles, paper, and plastic debris.[119]

One critic summarized the effects of pollutants in the Baltic Sea as of 1972 as follows:

> The Baltic is an example of such a partly stagnant basin. Its surface water has a very low nutrient content and large amounts of nutrients are accumulated in the deep water. Phosphorus is considered the limiting nutrient for primary production in the Baltic. As long as oxygen measurements have been carried out, the deep water has had a low oxygen concentration. Hydrogen sulphide formation has occasionally occurred in some isolated deep areas. The long series of oxygen measurements made since the 1890s on the international deep stations show that the oxygen concentration of the deep water during this century has decreased from about 3 ml/l to values close to zero. Hydrogen sulphide has several times appeared in the bottom water of the central basin. Increasingly larger areas have been poisoned. The last stagnation period produced hydrogen sulphide in the whole deep area of the Baltic proper. The deep water was renewed in 1969 and all hydrogen sulphide had disappeared in the winter of 1969-70. Recent measurements show, however, that the oxygen values are again fast decreasing and that hydrogen sulphide formation has again begun in the northern parts of the central basin.[120]

The ICES Group has estimated that organic matter equivalent to a biological oxygen demand of 1.2 million tons a year is dis-

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117. Fonselius, *On Eutrophication and Pollution in the Baltic Sea*, in MARINE POLLUTION AND SEA LIFE 23 (M. Ruivo ed. 1972).

118. *See id.*

119. *Id. See also supra* note 97 and accompanying text.

120. Fonselius, *supra* note 117, at 24-25.

charged into the Baltic in sewage and other waste products. The Group further estimated that the actual oxygen demand resulting from this waste discharge may be one to two mg O_2/m^3 per day.[121]

Investigations have revealed that about 14,000 tons of phosphorus are annually discharged into the Baltic, most of which is sewage generated.[122] There has been a noticeable increase in the concentration of phosphorus in sewage water from 1.5g per person a day to more that 4g per person a day over a study period of fifteen years.[123] The increased phosphorus levels may have a deleterious effect on the marine environment. Sea-water composition can play an instrumental role in changing the nitrogen/phosphorus ratio in phytoplankton cultures and in altering the species composition of the phytoplankton community. These alterations are believed to be responsible for accelerating problems such as red tide.[124]

Fortunately, all Baltic countries have actively participated in pollution research programs.[125] Regional cooperation is vital to the regulation and control of pollution. Moreover, with the advancement of technology and the growth of the shipping industry, international cooperation is imperative.

F. Transnational Marine Pollution

Marine pollution cannot be confined within national geographic boundaries.[126] The "World Ocean" is an indivisible, integrated, and unified ecological system.[127] Limits of national jurisdiction over economic and natural resources extending geographically or politically along a coastline and into waters out to twelve nautical miles for the territorial sea, or 200 nautical miles for extended

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121. *Id.* at 25. *See also* 1970 ICES REP., *supra* note 116.

122. Fonselius, *supra* note 117, at 24-25.

123. *Id.* at 25.

124. GESAMP, *supra* note 5, at 35-37.

125. For example, from 1969 to 1970, the Conference of Baltic Oceanographers, consisting of members worldwide, conducted "The Baltic Year." This was an investigation involving hydrographic surveys and sampling of plankton and bottom animals at a number of fixed stations. During the investigation, research ships from the various countries relieved each other to maintain continuity in the survey. Dybern, *Pollution in the Baltic*, in MARINE POLLUTION AND SEA LIFE 23 (M. Ruivo ed. 1972).

126. *See* Waldichuk, *supra* note 4, at 37.

127. Rusina, *International Legal Principles of Protection of the Marine Environment Against Pollution*, in THE LAW OF THE SEA AND INTERNATIONAL SHIPPING, ANGLO-SOVIET POST UNCLOS PERSPECTIVES 261 (W. Butler ed. 1985).

national jurisdiction, are unavailing in terms of controlling the mobility of pollutants. Effluents discharged by one coastal state can easily be carried into and degrade the waters of another when caught in littoral currents. Ships during the course of navigation can directly defile the waters of a coastal state by intentionally or accidentally discharging pollutants in these waters. Ships are also capable of indirect pollution of the waters of a coastal state. This pollution occurs when the vessel on the high seas discharges pollutants which are subsequently carried inshore by the currents.[128] Many factors mandate the need for a collective effort, comprised of all countries, to prevent and control transnational pollution. In short, an international regime is necessary.[129] Predictably, principles of international law are at the foundation of international cooperation.

Pollution of the environment flagrantly contravenes generally recognized principles of international law.[130] Under international law, a state may not exercise its sovereign rights in a manner which impedes the enjoyment by other states of their own rights or causes injury to territory or citizens of another state. This concept may be summarized by the maxim *neminem laedit qui suo jure utitur*, (*i.e.*, nobody harms another when he exercises his own rights).[131] Transnational pollution may also contravene the widely accepted principle of *jus cogens*. Freedom of the high seas has been considered a preemptory norm "accepted and recognized by the international community as a whole as a norm from which no derogation is permitted."[132]

An examination of the literature prior to the United Nations Convention on the Law of the Sea ("UNCLOS")[133] reveals that marine pollution problems did not occupy a prominent position in the hierarchy of international concerns and were consequently given scant consideration.[134] This is not to say that there is a pau-

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128. *See generally* R. CHURCHILL & A. LOWE, THE LAW OF THE SEA 212, 215 (1983) [hereinafter CHURCHILL & LOWE]; S. GERLACH, *supra* note 23, at 53-57; Waldichuk, *supra* note 4, at 51-54.

129. *See* Rusina, *supra* note 127, at 261-70.

130. *Id.* at 262.

131. Kiss, *Abuse of Rights*, in 7 ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW 1 (R. Bernhardt ed. 1984).

132. *See* Frowein, *Jus Cogens*, in 7 ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW 327 (R. Bernhardt ed. 1984).

133. U.N. Convention on the Law of the Sea, Dec. 10, 1982, 21 I.L.M. 1261.

134. *See* Ramakrishna, *Environmental Concerns and the New Law of the Sea*, 16 J. MAR. L. & COM. 1, 1 (1985).

city of material on marine pollution problems in literature generally. To the contrary, Grotius, Suarez, Vattel, and Wolf all made references to "defoulment," "marine contamination" and similar terms denoting marine pollution.[135] The cursory treatment of marine pollution problems in earlier writings on international environmental law suggests that marine pollution problems were seldom handled along with other major marine policy problems. The same indifference operated to foreclose marine pollution problems from consideration in the overall framework of international environmental law.[136]

III. INTERNATIONAL CASE LAW

The first formal recognition of the international implications of environmental pollution occurred in the context of terrestrial, not marine, pollution. Even today, despite the fact that seventy-one percent of the earth's surface is covered by water, most environmental legal energy is directed toward terrestrial pollution and its effects. In spite of a relative dearth of legal authority, important general principles have emerged from a line of cases focusing on international environmental legal issues.

A. The Trail Smelter Arbitration

Chronologically, responsibility for the injury by one state to the territory of another state was first recognized in an international context in the landmark *Trail Smelter* decision.[137] In that case, a Canadian company operated one of the largest zinc and lead ore smelting plants in the Northwest. These ores contained sulfur, which was discharged into the air as sulphur dioxide. The problems arose in the early 1930s when the daily rate of sulphur dioxide had risen to approximately 700 tons. As a result of the meteorological conditions in the area, these noxious fumes were blown over the Canada-United States border, located eleven miles south of Trail. Crops, timber, and livestock were severely damaged in the state of Washington.

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135. *See* Grieves, *Classical Writers of International Law and Environment*, 4 ENVTL. AFF. 309, 310 (1975); Kindt, *Prolegomenon to Marine Pollution and the Law of the Sea: An Overview of the Pollution Problem*, 11 ENVTL. L. 69, 69 (1980).

136. *See* Ramakrishna, *supra* note 134, at 1.

137. Trail Smelter (U.S. v. Can.), 3 R. Int'l Arb. Awards 1911 (1938).

Over the years, several private claims had been initiated against the Trail Smelter. However, attempts to settle the problems within the confines of municipal law and subsequent referral to the two states' International Joint Commission on Frontier Problems failed. In 1935, the two governments signed an agreement under which a tribunal was instituted to secure a permanent solution to the problem by means of arbitration. The tribunal was established to decide questions with respect to the nature and extent of the damage caused by the Trail Smelter, to impose remedial sanctions, including injunctive relief and indemnity, and to prescribe regimes to be "adopted or maintained by the Trail Smelter."[138]

The tribunal created by the convention was empowered to decide finally the following questions: 1) Whether any damage was caused by the Trail Smelter since January 1, 1932, and, if so, what indemnity should be paid therefor? 2) If the answer to the first part of the preceding question was affirmative, should the Trail Smelter be required to refrain from causing damage to Washington in the future, and, if so, to what extent? 3) In view of the answer to the preceding question, what measures or regime, if any, should be adopted or maintained by the Trail Smelter? 4) Pursuant to any decisions rendered by the tribunal on the preceding questions, what indemnity or compensation, if any, should be paid?[139]

The convention provided that the law to be applied was "the law and practice followed in dealing with cognate questions in the United States of America as well as international law and practice" and the tribunal was instructed to give "consideration to the desire of the high contracting parties to reach a solution just to all parties concerned."[140]

After surveying available precedents, the tribunal handed down its final decision on March 11, 1941, pronouncing that:

> . . . [N]o state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties of persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence . . . . Considering the circum-

138. Convention for the Establishment of a Tribunal to Decide Questions of Indemnity and Future Regime Arising from the Operation of Smelter at Trail, B.C., Apr. 15, 1935, United States-Canada, 49 Stat. 3245, 162 L.N.T.S. 73, [hereinafter Convention].

139. Convention, *supra* note 138, 49 Stat. at 3246, 162 L.N.T.S. at 76.

140. *Id.*

> stances of the case, the Tribunal holds that the Dominion of Canada is responsible in international law for the conduct of the Trail Smelter. Apart from the undertakings in the Convention, it is, therefore, the duty of the Government of the Dominion of Canada to see to it that this conduct should be in conformity with the obligation of the Dominion under international law. . . ."[141]

The United States was granted an award of indemnity for damages to timberland,[142] crops,[143] and cleared land not used for crops.[144] The decision also prescribed a regime over the Trail Smelter's emissions. An agreed reparation would be paid by Canada were future damage to occur notwithstanding the proper management and maintenance of the regime. The United States would be compensated up to $7,500 per year for any necessary investigations but only under the condition that the parties agreed that damage exceeding $7,500 had in fact occurred.[145]

The case is significant for introducing the principle of state responsibility for hazardous activities which cause injury to other states. The *Trail Smelter* case may be considered the *Rylands v. Fletcher*[146] of international law. The *Trail Smelter* case is cited in legal literature as the beacon for principles of state responsibility. No other international case at that time, and perhaps even up to the present day, so directly and exhaustively addressed the issues of transnational responsibility.[147]

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141. Trail Smelter, *supra* note 137, at 1965-66.

142. *Id.* at 1926-31.

143. *Id.* at 1924-25.

144. *Id.* at 1926. However, the tribunal denied indemnity on other United States' claims. These claims were denied based upon the United States' failure to prove the alleged damage or on the ground that, even if proved, the damage would be too indirect and remote to legitimate an award for indemnity. *Id.* at 1931. For instance, the United States had averred that slag disposal from the Trail Smelter had degraded the water quality in the Columbia River. No evidence, however, was proffered to substantiate the allegation. *Id.* at 1931-32. Additionally, although the United States had asserted that the health of its inhabitants was affected, the United States failed to claim any indemnity for the alleged injury. *Id.* at 1961.

145. *Id.* at 1974-78.

146. Rylands v. Fletcher, 3 L.R.-E. & I. App. 330 (1868). Rylands is the leading case from which the doctrine of strict liability for abnormally dangerous activities has developed. *See* W. KEETON, D. DOBBS, P. KEETON & D. OWEN, PROSSER & KEETON ON TORTS 545 (5th ed. 1984).

147. Article VIII of the Convention instructed the tribunal to consider the evidence proffered by the interested parties and authorized it to conduct investigations. *See* Convention, *supra* note 138, 49 Stat. at 3247, 162 L.N.T.S. at 78. The tribunal took full advantage of this mandate. The use of such extraordinary judicial powers represented an innovation in

B. The Corfu Channel Case

The next decision of consequence was the *Corfu Channel* Case.[148] In this dispute the court rendered three judgments. The first judgment was a rejection of the preliminary objection submitted by the Albanian Government.[149] In the second, the court found Albania responsible for certain explosions in Albanian waters and liable for the ensuing damage and loss of human life. The court also enumerated the activities of the British Navy which did and did not contravene Albania's sovereignty.[150] The third judgment assessed the amount of compensation for which Albania was liable.[151]

The incident which gave rise to the litigation occurred on May 15, 1946, when the British Admiralty sent two warships to the Corfu Channel located between the Albania mainland and the northern portion of the island of Corfu. The channel was considered mine-free, since the mines that were placed during World War II had been swept in October 1944. During their cruise through the Channel, the British warships were fired upon, but not hit.

In an exchange of notes, the British government announced that it had a right to pass through the straits and was not required to announce the passage beforehand or await permission from Albania. Albania asserted that its permission for passage was re-

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the arbitration of international disputes. The scientific investigation by the tribunal has been described as "probably the most thorough study of an area subject to atmospheric pollution by industrial smoke." *See* Read, *The Trail Smelter Dispute*, 1 CAN. Y.B. INT'L L. 213, 229 (1963). The Trail Smelter Case's merit as precedent, however, has been challenged on several grounds. The case has been cited as authority for the imposition of a strict liability standard applicable to ultrahazardous activities under international law. However, the facts of the case do not support the existence of such strict liability principles for the simple reason that Canada's liability for damages was not at issue; she had conceded liability at the outset. *See* Rubin, *Pollution by Analogy: The Trail Smelter Arbitration*, 50 OR. L. REV. 259, 264 (1971).

The Trail Smelter Case's value as a precedent has also been challenged because of the tribunal's use of international law by analogy from United States Supreme Court decisions. Critics point out the fundamental differences between a national court in a federal system and a non-centralized, voluntary system of arbitration. Closely related to this criticism is the complaint that the tribunal erroneously applied common law torts; the principles of United States law underlying the tribunal's decision were premised on theories of nuisance and trespass, two common law doctrines foreign to international law. *See id.* at 268-71.

148. Corfu Channel (U.K. v. Alb.), 1947 I.C.J. 4.

149. *See* Corfu Channel (U.K. v. Alb.), 1948 I.C.J. 15 (Judgment of Mar. 25, 1948).

150. *See* Corfu Channel (U.K. v. Alb.), 1949 I.C.J. 4-169 (Judgment of Apr. 9, 1949).

151. *See* Corfu Channel (U.K. v. Alb.), 1949 I.C.J. 244 (Judgment of Dec. 15, 1949).

quired. The British Admiralty dispatched two cruisers and two destroyers to the Corfu Channel. The two destroyers struck mines and were badly damaged; many people died or were injured. Several weeks following the incident the British Navy independently and unilaterally conducted mine-sweeping operations in the channel. Before this undertaking, the British had communicated their intentions to the Albanians, to which the Albanians replied with strong protests.[152]

On May 22, 1947 the United Kingdom unilaterally instituted a proceeding before the International Court of Justice. Albania contested the court's competence. After the court rendered its first judgment, the two parties submitted a *compromis* in which the court was petitioned to decide whether Albania was responsible for the explosions in the channel and whether the United Kingdom had infringed upon Albania's sovereign rights.

In the proceeding on the merits of the case, the court ruled that Albania's presumed knowledge of the presence of the minefield in Albanian territorial waters obligated the Albanian government to notify "for the benefit of shipping in general, the existence of the minefield in Albanian territorial waters" and to warn "the approaching British warships of the imminent danger to which the minefield exposed them."[153] The court ruled that Albania had failed to meet this obligation and was therefore responsible under international law for the explosions that occurred in her waters and for the ensuing damage and loss of human life. The court also ruled the British Navy's mine-sweeping operation in Albanian waters had "violated the sovereignty of the People's Republic of Albania."[154]

While the *Corfu Channel* case is widely cited for its holding on the question of innocent passage through straits,[155] the case is

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152. *See* Corfu Chanel, *supra* note 150, at 27.

153. *Id.* at 22.

154. *Id.* at 35-36.

155. The court stated:

> It is, in the opinion of the court, generally recognized and in accordance with international custom that states in time of peace have a right to send their warships through straits used for international navigation between two parts of the high seas without previous authorization of a coastal state, provided that the passage is *innocent*. Unless otherwise prescribed in an international convention, there is no right for a coastal state to prohibit such passage through straits in time of peace.

Id. at 28 (emphasis in original).

an important precedent for the doctrine of state responsibility. It reinforced and extended the *Trail Smelter* ruling.[156]

The *Corfu Channel* decision held that a state cannot exercise its sovereignty in a manner which causes injury to other states within its territory. A state may not exercise its sovereignty with a reckless disregard for the welfare of others. In a marine pollution context, under principles of international law, a state should be held responsible when it recklessly allows the discharge of pollutants into its own waters, thereby causing injury to the waters of its neighbors.

C. The Lac Lanoux Case

The *Lac Lanoux* Arbitral Award[157] involved a controversy between France and Spain over the use of the Lac Lanoux's waters and the interpretation of the Treaty of Bayonne of 1866. Lac Lanoux lies in French territory and has its source therein. The waters flow naturally into the River Carol, which runs into Spain and joins the River Segre, flowing eventually into the Mediterranean. Spain, the lower riparian, claimed that France could not unilaterally decide to divert the waters of Lac Lanoux as part of a hydroelectric project.[158] The question put before the tribunal was whether France had violated the Treaty of Bayonne of 1866 by constructing a plant with the intention of using the waters of Lac Lanoux without the prior consent of the Spanish Government.[159]

Spain contended that the French project affected the entire water system of the Carol and the diversion of the waters would alter and degrade the physical features of the hydrographic basin. The arbitral tribunal rejected Spain's claim since it failed to show that "the works would bring about a definite pollution of waters of the river Carol which flowed from Lac Lanoux into Spain and to which the diverted water would be returned or that returned waters would have a chemical composition or a temperature or some other characteristic which could injure Spanish interest."[160]

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156. *See supra* notes 137-147 and accompanying text.
157. Lake Lanoux (Spain v. Fr.), 12 R. Int'l Arb. Awards 281 (1957).
158. *See id.* at 295-96.
159. *Id.* at 301.
160. *Id.* at 303.

D. The Japanese Fishermen Incident

The Japanese Fishermen[161] incident provides a concrete example of flagrant abuse of state's rights. In that incident, the United States conducted hydrogen bomb tests in the Marshall Islands. Unlike the previous two cases, no tribunal was instituted to decide liability and damages issues. However, through diplomatic agreement, the United States paid two million dollars to the Japanese government as compensation for subjecting a crew member of a Japanese fishing boat to excessive amounts of radiation and for contaminating the catch of a number of other fishermen. The United States was severely criticized for conducting these dangerous tests. Critics asserted that the testing violated the trusteeship agreement, and was unlawful under international law because it was in violation of the U.N. Charter.[162] Commentators maintained that even though the United States may not have been guilty of a violation per se, the standard of reasonableness should apply in international conflicts over environmental pollution.[163] "The standard should be determined by the familiar process of balancing the 'utility of the conduct' causing damage against the 'gravity of the harm' to the injured party."[164] One principle emerges from this case: regardless of the propriety or impropriety of the action, a state is responsible for the action if it results in an injury or damage. The case demonstrates that by 1954 the concept of state responsibility for damage caused by pollution was beginning to find acceptance.

E. Pollution of Ciudad Juarez

On April 6, 1961 in a note to the United States Secretary of State, the Chargé d'Affaires *ad interim* of Mexico complained of offensive odors caused by two American companies alleged to have been "polluting the air with gaseous fumes [and] throwing fetid offal into the Rio Grande," resulting in "serious physical and economic damage" to the inhabitants and commerce of Ciudad Jua-

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161. For a discussion of the incident, see Margolis, *The Hydrogen Bomb Experiments and International Law*, 64 YALE L.J. 629, 637-39 (1955); Arnold, *The Effects of the Recent Bomb Test on Human Beings*, 10 BULL. ATOMIC SCIENTISTS 347 (1954).

162. *See* Margolis, *supra* note 161, at 629-30.

163. McDougal & Schlei, *The Hydrogen Bomb Tests in Perspective: Lawful Measures for Security*, 64 YALE L.J. 648, 691 (1955). *See also* McDougal, *The Hydrogen Bomb Tests and the International Law of the Sea*, 49 AM. J. INT'L L. 356, 361 (1955).

164. McDougal & Schlei, *supra* note 163, at 691.

rez.[165] The Mexican Government requested that the United States take appropriate measures to have the companies "cease to cause odor to be emitted from their plants, to pollute international waters illegally by throwing offal into the Rio Grande, and to discharge gaseous fumes in preparing their products, all of which is causing serious injury to the people of Ciudad Juarez, Chihuahua, Mexico."[166]

The Secretary responded by apprising the Mexican Government of the measures taken by the companies "at considerable costs" to abate the nuisance,[167] and announced: "The Department is gratified that it can make so favorable a report in a matter of concern to the Government of Mexico."[168]

F. Summation of Precedential Principles

The value of these precedents is derived from the development of generally recognized principles of international law embodied in the international legal protection of the environment. Through these precedents, international norms for state responsibility and conduct have been established. These cases, read together, establish a general rule of international law that states must not permit their nationals to discharge into the sea effluents that may cause injury to the nationals of other states. However, this rule has been criticized for its vagueness. It has been suggested that the general, broad and non-specific nature of international law makes it ineffective in the development of detailed emission standards required to protect the international environment.[169] The development of customary international law has been considered by many states to be both imperfect and incapable of progressing expeditiously to the extent required to effectively restrict pollution.[170]

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165. M. WHITEMAN, DIGEST OF INTERNATIONAL LAW 256-57 (1968).

166. *Id.* at 258.

167. *Id.* at 258-59.

168. *Id.* at 259.

169. CHURCHILL & LOWE, *supra* note 128, at 216.

170. Certain countries have resorted to their own preventative measures. For example, in 1970, the Canadian Parliament was extremely concerned about the potential injury to the fragile Arctic Waters by oil tankers in passage through Arctic Waters. To protect these waters, it passed the Arctic Waters Pollution Prevention Act, which prohibits all pollution and regulates shipping within 100 miles of Canada's Arctic coast. *Id.*

IV. The Role of International Organizations in the Regulation of Vessel-Generated Pollution

As a result of some of the shortcomings of legal development, international organizations were created to accelerate the development of international pollution regimes. A few of these organizations merit mention. One of the earliest organizations to devote its efforts to marine pollution problems was the International Council for the Exploration of the Sea, established in 1902. This organization, however, was a scientific organization with no regulatory powers and confined itself to the North Atlantic and Baltic Seas.[171]

Later, the Inter-Governmental Oceanographic Commission was established in 1950 by UNESCO to "promote, plan, and execute, through concrete action of its member states, international cooperation in marine research and monitoring programmes, and to provide ocean services."[172]

The 1948 United Nations Maritime Conference, held in Geneva, adopted a Convention creating the Inter-Governmental Maritime Consultative Organization ("IMCO"), now known as the International Maritime Organization ("IMO").[173] Until the formation of the United Nations Environmental Programme ("UNEP"), IMO was the sole organization in the field of marine environmental protection and preservation. IMO is specifically entrusted with the task of prevention and control of pollution from ships and related legal matters.[174] The Organization has two committees—the Marine Environmental Protection Committee ("MEPC") and the Legal Committee—which were established after the *Torrey Canyon* incident in 1967 to prepare draft conventions for the prevention and control of marine pollution from ships. The conventions drafted or implemented by the Legal Committee include:

1) International Convention for the Prevention of Pollution of the Sea by Oil;[175]

2) International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties;[176] Protocol

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171. *See* Ramakrishna, *supra* note 134, at 2.

172. *Id.* at 2-3.

173. Convention creating the Inter-Governmental Maritime Consultative Organization, Mar. 6, 1948, 9 U.S.T. 621, T.I.A.S. No. 4044, 289 U.N.T.S. 48.

174. International Maritime Organization Convention, art. I, 9 U.S.T. 621, 623, T.I.A.S. No. 4044, at 3, 289 U.N.T.S. 48, 48.

175. May 12, 1954, 12 U.S.T. 2989, T.I.A.S. No. 4900, 327 U.N.T.S. 3.

176. Nov. 29, 1969, 26 U.S.T. 765, T.I.A.S. No. 8068, 9 I.L.M. 25.

Relating to Intervention on the High Seas in Cases of Marine Pollution by Substances Other Than Oil;[177]
3) International Convention on Civil Liability for Oil Pollution Damage;[178] Protocol to the International Convention on Civil Liability for Oil Pollution Damage;[179] Protocol to Amend the International Convention on Civil Liability for Oil Pollution Damage;[180]
4) International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage;[181] Protocol to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage;[182] Protocol to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage;[183]
5) International Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material;[184]
6) Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter;[185]
7) International Convention for the Prevention of Pollution from Ships;[186] Protocol Relating to the International Convention for the Prevention of Pollution from Ships.[187]

In 1972, an inter-governmental working group was created to conduct a comprehensive survey of all environmental problems and to submit recommendations to the 1972 U.N. Conference on Human Environment. In 1974, UNEP established the Regional Seas Programme ("RSP"), which presently includes eleven regions and has the participation of more than 125 coastal states. Agreements and action-oriented programs have developed in such regions as the Mediterranean area, the Red Sea area, and the Central African region. Relevant conventions and subsequent protocols include the following:

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177. Nov. 2, 1973, T.I.A.S. No. 10561, 13 I.L.M. 605.
178. Nov. 29, 1969, 9 I.L.M. 45.
179. Nov. 19, 1976, 16 I.L.M. 617.
180. *Documents*, 15 J. MAR. L. & COM. 613 (1984).
181. Dec. 18, 1971, 11 I.L.M. 284.
182. Dec. 17, 1971, 16 I.L.M. 621.
183. *Documents*, 15 J. MAR. L. & COM. 623 (1984).
184. Dec. 17, 1971, 11 I.L.M. 277.
185. Nov. 13, 1972, 26 U.S.T. 2403, T.I.A.S. No. 8165, 11 I.L.M. 1294.
186. Nov. 2, 1973, 12 I.L.M. 1319.
187. Feb. 17, 1978, 17 I.L.M. 546.

1) Convention for the Protection of the Mediterranean Sea Against Pollution;[188] Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft;[189] Protocol Concerning Cooperation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances;[190]
2) Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution;[191] Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency;[192]
3) Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region;[193] Protocol Concerning Regional Cooperation in Combating Pollution in Cases of Emergency;[194]

Outside the U.N. System, there are some regional conventions on the subject of marine pollution:

1) Convention on the Protection of the Rhine Against Chemical Pollution;[195]
2) Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil;[196]
3) Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft;[197]
4) Convention on the Protection of the Marine Environment of the Baltic Sea Area;[198]
5) Convention for the Prevention of Marine Pollution from Land Based Resources;[199]

In general, one of the tragic flaws in the IMO conventions was that they were adopted under emergency conditions as a reaction

188. Feb. 16, 1976, 15 I.L.M. 290.
189. *Id.* at 300.
190. *Id.* at 306.
191. Apr. 24, 1978, 17 I.L.M. 511.
192. *Id.* at 526.
193. Mar. 23, 1981, 20 I.L.M. 746.
194. *Id.* at 756.
195. Dec. 3, 1976, 16 I.L.M. 242.
196. June 9, 1969, 9 I.L.M. 359.
197. Feb. 15, 1972, 11 I.L.M. 262.
198. Mar. 22, 1974, 13 I.L.M. 555.
199. June 4, 1974, 13 I.L.M. 352.

to some major disaster.[200] Against this backdrop, the drafters lacked sufficient time for reasoned and careful planning. The conventions are characterized by stop-gap, fragmented installation measures. Rather than developing a comprehensive approach for the control and prevention of all types of vessel-generated pollution, the approach is usually according to pollutant type (*e.g.*, oil, nuclear wastes and garbage) or the means by which pollutants are introduced into the marine environment (*e.g.*, dumping, routine tanker operations, etc. . .). Another piecemeal approach is a locality approach which deals with marine pollution according to whether its location is in the territorial waters, exclusive economic zone or the high seas.

A. The MARPOL Convention and Vessel-Generated Pollution

The primary convention that expressly addressed the ship-generated wastes of sewage and garbage was the International Convention for the Prevention of Pollution from Ships ("MARPOL").[201] The MARPOL Convention was intended to manage all forms of intentional discharges of pollutants except dumping into the sea from vessels. There are five annexes to the MARPOL Convention which provide detailed standards for pollution control. Of particular importance are two optional annexes, Annex IV and Annex V. Annex IV contains standards for vessel-source sewage.[202] Under Annex IV, the discharge of sewage between four and twelve miles from land is prohibited, unless a vessel is equipped with an operable, approved marine sanitation device.[203] Ships may not discharge sewage within four miles of shore.[204] Annex V prohibits the ocean disposal of all plastics and prescribes precise minimum distances from shore for the disposal of all the main types of garbage.[205] Unfortunately, MARPOL was never ratified by a sufficient number of maritime states to enable the convention to enter into force internationally. MARPOL was superceded by the Protocol of 1978, relating to the International

200. The Legal Committee of the IMO, for example, was established after the Torrey Canyon disaster in 1967. Ramakrishna, *supra* note 134, at 4.

201. Nov. 2, 1973, 12 I.L.M. 1319.

202. *Id.* at 1424-34.

203. *Id.* at 1429-30.

204. *Id.*

205. *Id.* at 1434-38.

Convention for the Prevention of Pollution from Ships, 1973 (1978 MARPOL Protocol). The 1978 MARPOL Protocol is a product of the Tanker Safety and Pollution Prevention Conference held in London during February, 1978, in response sixteen tanker accidents which occurred in United States waters during the winter of 1976-1977.[206]

Consistent with the traditional piecemeal approach to marine pollution, upon the ratification and incorporation of the 1978 MARPOL Protocol in United States law in 1980, the United States version failed to include the two optional annexes, regulating sewage and garbage pollution. However, eight years later on December 31, 1988, Annex V of the 1978 MARPOL Protocol, entitled "Regulations for the Prevention of Pollution by Garbage from Ships" went into force in the United States and across the globe.[207] Nevertheless, the future implementation of Annex IV which calls for the prevention of sewage pollution remains uncertain, absent its ratification as a reaction to some environmental calamity.

B. UNCLOS III and Pollution from Ships

At the commencement of the U.N. Third Law of the Sea Conference ("UNCLOS III") sessions in 1974,[208] one committee was assigned to formulate draft articles on marine pollution. Efforts were made during the eight years of deliberation to negotiate a multilateral treaty that would deal with all ocean activities. Part XII of UNCLOS III, which consists of forty-two articles dealing with pollution from vessels and the preservation of the marine environment, is particularly noteworthy.[209] Coastal states may establish their own regulations for pollution control for ships entering their internal waters or passing through their territorial seas.[210] However, in the exclusive economic zone, the area from twelve to two hundred miles from their baselines, coastal states are limited to imposing regulations conforming to generally accepted interna-

206. For the legislative history of the 1978 MARPOL Protocol in the United States, see the Prevention of Pollution From Ships Act, Oct. 21, 1980, Pub. L. No. 96-478, 1980 U.S. CODE CONG. & ADMIN. NEWS 4849 (94 Stat. 2297) (codified at 33 U.S.C. §§ 1901-1911).

207. The codified version of Annex V appears at 33 U.S.C. §§ 1901-1911 (1982), *amended by* Tit. II of Pub. L. No. 100-220, 101 Stat. 1458.

208. United Nations Convention on the Law of the Sea, Dec. 10, 1982, 21 I.L.M. 1261.

209. *Id.* at 1308-16.

210. *Id.* at 1310-11.

tional rules established through international organizations.[211] Throughout the rest of the convention, a good faith effort was made to strike a balance between the coastal states' interest in protecting their environment from the ravages of pollution and the interest of maritime and shipping states in obtaining expeditious and inexpensive passage of their vessels through the high seas.[212]

The text departs from traditional international law by providing for the arrest, prosecution, and punishment of vessels violating applicable international pollution rules by the port state whose territorial waters or exclusive economic zone is threatened by such violations.[213] However, the Flag State retains the right to administer justice to one of its own vessels for violations in the exclusive economic zone.[214] Here the text exemplifies the convention's policy of balancing the coastal states' interests in protecting their resources while not denying primary legal responsibility of the Flag State for its vessel in another's exclusive economic zone or on the high seas. While this makes for friendly international relations, it may not prove to be an effective enforcement measure.

Although the UNCLOS III provides the most comprehensive approach to marine pollution problems, it too, has its deficiencies. UNCLOS III provides broad general principles that lack the detailed prescriptions necessary for effective administration of an international pollution-control regime. Article 192 merely enunciates a general obligation on the part of states to protect and preserve the marine environment. The convention is more concerned with defining the jurisdictional rights and obligations of flag, coastal, and port states than it is in elaborate substantive standards.

Typically, the convention had oil pollution in mind when it drafted its provisions on vessel-generated pollution, the *Torrey Canyon* disaster having occurred shortly before the beginning of the conference. Unfortunately, however, there are no provisions that specifically deal with the discharge of garbage and sewage.[215] No evidence exists that this type of pollution was of concern at the conference.

UNCLOS III should have looked to the MARPOL Convention, particularly Annexes IV and V, for guidance. Apparently the

211. *Id.*
212. *Id.* at 1308-16.
213. *Id.* at 1312.
214. *Id.*
215. *Id.* at 1310-11.

thinking of the conference was that because of the numerous bilateral and regional conferences dealing with the various aspects and sources of marine pollution, it was unnecessary for UNCLOS III to provide a detailed and technical approach to pollution problems. To do so may have been beyond the scope of the convention. Since the convention was the product of a "package deal," a detailed standardized pollution regime would have come at the expense of a consensus. Developing nations did not regard protection of the environment as high a national priority as the developed countries did. In fact, these nations regarded the major powers' promotion of conservation with suspicion. This approach was seen as an attempt to curtail Third World development.

UNCLOS III declined to seize the opportunity and provide the world with the type of functional standards needed to effectively and efficiently regulate all forms of vessel source pollution on the global level. The adoption of the detailed, standardized regulatory scheme of MARPOL Annexes IV and V might have provided the world with a workable pollution regime. However, had the convention in fact adopted the MARPOL approach, the regime still would have been subject to the same deficiencies as that of UNCLOS III. No matter what type of international pollution regime is instituted, it may prove to be unenforceable if no international central enforcement regime is also instituted.

Closely related to the central enforcement problem is the question of states not parties to the convention, should an international pollution regime ever come into force. Most commentators contend that because the convention is a codification of customary international law, the provisions of the convention are enforceable according to already existing principles of international law. It is generally accepted that pollution of another state's environment is a violation of international law, as evidenced from years of state practice and *opinion juris*, and, therefore, binding upon virtually all states. Assuming, *arguendo*, that protection of the environment has reached the level of customary international law, the very general and broad provisions of Part XII of UNCLOS III would be considered merely a codification of international law. Arguably, as a result of wide state practice over a substantial time period, and as evidenced by bilateral, regional and multilateral treaties, prevention of vessel-source oil pollution may have risen to the level of international law. Nevertheless, the conspicuous absence of data on and treatment of the subject in national and international envi-

ronmental law literature may suggest that the prevention of vessel-source sewage and garbage pollution is not a principle of international law and perhaps not yet a problem of great international concern.

V. Conclusion

In arriving at a national or global vessel-source pollution prescriptive or enforcement structure, two countervailing considerations must be reconciled and balanced: the interests of the maritime shipping community in preserving freedom of navigation, and the interests of coastal areas in preserving their respective coastal ecosystems. Navigation for commercial and military purposes is one of the oldest and most prevalent uses of the sea. Nevertheless, while some degree of pollution is unavoidable, monitoring and regulation of levels of contamination is required. Obviously, it would be impracticable to search the oceans for every potential pollutant and monitor its concentrations. A more rational approach would be to examine known contaminants, such as sewage and plastics, and to concentrate efforts in critical areas of known input to collect data necessary to achieve more accurate predictions of environmental impact.

Generally, there are a limited number of places for waste disposal: the atmosphere, the ground, and the ocean. It is only reasonable to use the oceans for waste disposal where empirical studies demonstrate that this natural dumping ground appears to provide the most ecologically sound environmental option.