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THE INTERNATIONAL COMMUNITY CONFRONTS PLASTICS POLLUTION FROM SHIPS: MARPOL ANNEX V AND THE PROBLEM THAT WON'T GO AWAY

Paul E. Hagen*

"The capacity of the sea to assimilate wastes and render them harmless and its ability to regenerate natural resources are not unlimited."

INTRODUCTION

Marine plastics pollution is a growing international dilemma that threatens marine resources from the crowded New Jersey shore\(^1\) to the otherwise pristine and uninhabited beaches of Antarctica.\(^2\) Plastic debris is found in oceans around the globe,\(^3\) and its durability ensures its


1. See Controlling and Reducing Pollution from Plastic Waste: Hearings on S. 539, S. 560 and S. 633 Before the Subcomm. on Environmental Protection of the Senate Comm. on Environment and Public Works, 100th Cong., 1st Sess. 49, 50 (1987) [hereinafter Hearings on Controlling and Reducing Pollution from Plastic Waste] (statement of Sen. Lautenberg) (recounting a 1986 beach cleanup in Sandy Hook, New Jersey). In one hour 15 people collected 700 plastic containers and six-pack rings and 600 plastic tampon applicators and assisted in filling a flatbed truck with refuse, eighty percent of which was plastic. *Id.* Plastics pollution continues to threaten New Jersey's seven billion dollar per year coastal tourism industry. *Id.* During the summer of 1987, large volumes of marine debris washed onto beaches in the New York-New Jersey area, twice forcing beach closures. Natl Oceanic and Atmospheric Admin., Dept. of Commerce, Report of the Interagency Task Force on Persistent Marine Debris 34 (1988) [hereinafter Interagency Task Force]. Gateway National Recreation Area in New York and New Jersey spent over $500,000 to clean 53 miles of beach in 1987. *Id.* During "COASTWEEKS '88" (September 17 - October 10) 250 volunteers in New Jersey cleaned 15 miles of shoreline and collected over 10,000 pounds of debris, 94% of which was plastic. Center for Marine Conservation, Trash on America's Beaches: A National Assessment 1-9 (1989) [hereinafter Trash on America's Beaches]. The Center for Marine Conservation (formerly the Center for Environmental Education) in Washington D.C. is an excellent source for legal and statistical information concerning the problems of marine debris. Authorities cited in this article, to the extent practical, are on file with the Center.


3. See id. at 307, 309 (discussing plastics pollution in many of the world's oceans); infra note 29 (discussing the international nature of the plastics debris problem).
presence for centuries to come.\(^4\) Although there are many sources of marine debris, the centuries-old maritime practice of disposing of ship wastes at sea is a primary source of marine plastics pollution.\(^6\)

The National Academy of Sciences estimates that 6.4 million tons of trash is dumped into the world's oceans every year, 45,000 tons of which is plastic.\(^6\) Merchant fleets are estimated to deposit over 639,000 plastic containers into the ocean daily.\(^7\) Each night commercial fisheries of the Pacific Ocean set out enough synthetic gill netting to reach halfway around the globe,\(^8\) often losing nets up to 15 kilometers in length.\(^9\) These lost or discarded "ghost nets" continue to indiscrimi-

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\(^5\) See Nat'l Ocean Policy Study Hearings, supra note 4, at 46 (statement of Gary Mauro, Texas Land Commissioner) (commenting that "[a] 4,000 year maritime tradition of dumping ship garbage at sea posed little problem until World War II, but the advent of modern plastic just makes the practice totally unacceptable"). Historically, ships have disposed of their wastes at sea. Id. at 91 (statement of Joseph J. Cox, Director, Marine Affairs American Institute of Merchant Shipping). See also infra note 49 (discussing current waste disposal practices for ships at sea).

\(^6\) NAT'L ACADEMY OF SCIENCES, Marine Litter in Assessing Potential Ocean Pollutants 405, 408, 422 (1975) [hereinafter NAS, Assessing Potential Ocean Pollutants]. The study estimates that .07 percent of the estimated 6.36 million tons of waste produced at sea is plastic. Id. The NAS study is considered the most comprehensive survey of data on marine sources of debris, even though the work is dated and the sources lacked precision. INTERAGENCY TASK FORCE, supra note 1, at 42 n.1. The NAS study was based on 1972 surveys by five countries submitted to the International Maritime Consultative Organization (IMCO). EASTERN RESEARCH GROUP, FINAL REPORT TO THE UNITED STATES COAST GUARD, A REGULATORY EVALUATION OF REGULATIONS IMPLEMENTING ANNEX V TO MARPOL 4-3 (Dec. 7, 1988) [hereinafter Regulatory Evaluation of Annex V].

\(^7\) Horsman, The Amount of Garbage Pollution from Merchant Ships, 13 MAR. POLLUT. BULL. 167, 168 (1982). Wastes from merchant ships include crew-generated domestic wastes and cargo-associated wastes such as dunnage, shoring pallets, wires, and plastic sheeting. Id.

\(^8\) Laist, Overview of the Biological Effects of Lost and Discarded Plastic Debris in the Marine Environment, 18 MAR. POLLUT. BULL. 319, 322 (1987).

\(^9\) See id. at 321 (noting two examples of synthetic fishing nets recovered in the Pacific Ocean that contained a variety of sea life). One of these nets was a 1500-meter gill net, the other a 15-kilometer drift net. Id. Commercial fisheries may generate as much as 135,000 metric tons of plastic debris annually. Plastic Pollution in the Marine Environment: Hearings Before the Subcomm. on Coast Guard and Navigation of the
nately kill marine life for years, impacting on both the marine ecosystem and commercial fisheries.10

Plastics in the ocean kill marine mammals, seabirds, turtles, and fish through entanglement or ingestion.11 Plastic debris also damages vessels and degrades beaches world-wide.12 In addition, significant cleanup and repair costs are incurred by governments and individuals due to the prevalence of this debris.13

The enormous growth of the plastics industry in recent years is largely responsible for the increasing plastics pollution of the world's oceans.14 In 1987, the United States produced over 55 billion pounds of plastic resin.15 Plastics are now used for a variety of consumer and industrial products previously fabricated from degradable materials.16 The lightness, buoyancy, strength, and durability of plastics render them increasingly popular for consumer and industrial products.17 Unfortunately, these same qualities cause plastic debris to seriously threaten living marine resources.18


10 See CENTER FOR ENVIRONMENTAL EDUCATION, PLASTICS IN THE OCEAN: MORE THAN A LITTER PROBLEM, iii (1987) (K. O'Hara and S. Judicello principal authors) [hereinafter PLASTICS IN THE OCEAN] (explaining that discarded gill nets continue to catch large numbers of commercially valuable sea life). In 1985, Atlantic gill net fisheries lost approximately 30 miles of netting off the New England Coast. Id.

11 See infra notes 61-90 and accompanying text (detailing the environmental hazards posed by plastics pollution).

12 See PLASTICS IN THE OCEAN, supra note 10, at iii.

13 See infra notes 97-114 (discussing the economic impacts of marine plastics pollution).

14 See infra notes 31-40 (discussing the growth of the plastics industry).


16 See Bean, Legal Strategies for Reducing Persistent Plastics in the Marine Environment, 18 MAR. POLLUT. BULL. 357, 358 (1987) (stating that garbage bags, cups, bottles, milk and beverage containers, and industrial products such as strapping bands, plastic sheeting, and packing materials are increasingly made of plastic).

17 See infra note 38 (discussing the properties of plastics).

18 Fruter, supra note 2, at 305; see Weisskopf, Plastic Reaps a Grim Harvest in the Oceans of the World, SMITHSONIAN Mar. 1988, at 59, 60 [hereinafter Weisskopf, Grim Harvest] (discussing the dangerous properties of plastics in marine environments).

thirty-nine nations representing approximately fifty-seven percent of the world's gross shipping tonnage have ratified the Annex. Annex V prohibits ship disposal of plastics into marine waters and imposes strict requirements for the disposal of other garbage. United States ratification of Annex V placed the shipping tonnage of parties to the Annex above the fifty percent required to bring the regulations into force.

Although ratification of Annex V of MARPOL renders the discarding of plastics into the sea unlawful, it is unclear whether Annex V will substantially reduce marine plastics pollution. For example, difficult
questions remain concerning state jurisdiction and enforcement powers under Annex V,24 and whether states will provide adequate port facilities for receiving regulated wastes.25 The limits of the Annex in diminishing the loss of synthetic fishing gear26 and the environmental consequences of increased at sea incineration and ash disposal are also uncertain.27

Part I of this Comment provides an overview of the primary sources and quantities of marine plastics pollution. The environmental and economic impacts of plastics in marine waters are also examined. Part II examines the regulation of plastic pollution from ships and analyzes the inadequacy of previous international and United States law governing vessel source plastics pollution. This section also surveys the role of the International Maritime Organization (IMO) and the evolution of the 1973 MARPOL Convention and Protocol of 1978. Part III discusses the enforcement regime of Annex V as well as United States implementing legislation and interim regulations. Part IV analyzes the limits of Annex V and United States implementing legislation in regulating plastic pollution from ships. This part also examines the problems likely to occur through increased and largely unregulated on-board incineration. The Comment concludes with recommendations for strengthening both domestic and international prohibitions on the disposal of ship generated plastic and ash at sea.

I. MARINE PLASTICS POLLUTION: AN INTERNATIONAL PLIGHT

A. SOURCES AND AMOUNTS OF MARINE PLASTICS POLLUTION

Plastics28 pollute marine waters world-wide.29 The plastics industry


24. See infra notes 319-38 (addressing jurisdiction and enforcement under MARPOL).

25. See infra notes 339-47 and accompanying text (discussing the question of adequate port facilities under Annex V).

26. See infra notes 348-60 (discussing continued problems with lost nets).

27. See infra notes 363-91 (addressing the hazards of at-sea incineration).


29. See Pruter, supra note 2, at 305, 309 (documenting studies on marine plastic pollution in the form of debris and/or pellets in the waters or on the shores of Japan, Alaska, Hawaii, New Zealand, Cape Cod, Java, Antarctica, Canada, Bermuda, Scot-
originated over 150 years ago, but it grew substantially during World War II in response to the shortage of other materials. Total plastic production in the United States has grown from roughly 6 billion pounds in 1960 to over 55 billion pounds in 1987. Plastic production in other countries has continued to expand as well. In 1985, the United States plastics industry produced over 138 billion dollars in finished goods. The 1.2 trillion cubic inches of plastic produced that

Island, Great Britain, France, Denmark, Lebanon, Spain, and Mediterranean Sea; see also Nat'l Oceanic and Atmospheric Admin., Dep't of Commerce, Technical Memorandum NMFS-SWFC-54, Proceedings of the Workshop on the Fate and Impact of Marine Debris (R. Shomura & H. Yoshida eds.) (Nov. 27-29, 1984) [hereinafter Workshop on Marine Debris] (discussing plastics pollution from ocean and land-based sources in the North Sea, the Northwest Atlantic Ocean, the wider Caribbean, and the Baja coast of the Pacific Ocean). A 1987 survey of over 209 kilometers of beach in the Netherlands found 30% of the litter originated from sources at sea and that plastics accounted for approximately 41% of the debris collected. Dutch Beaches Litter Survey, 19 MAR. POLLUT. BULL. 46 (1988).

A one day, 58-mile beach clean-up in 1987 of the Padre Island National Sea Shore in Texas recovered 3,646 plastic bags, 3,154 plastic caps, 3,039 plastic bottles, 3,037 pieces of styrofoam, 1,993 pieces of synthetic rope, and 1,087 six pack holders. Interagency Task Force, supra note 1, at 31. Recent studies indicate that Padre Island National Seashore receives approximately 580 tons of marine debris per year or over ten tons per mile of beach. Id. at 29; TRASH ON AMERICA'S BEACHES, supra note 1 (detailing a state-by-state analysis of marine debris collected in the United States during Coastweeks '88).

30. H. Simonds, A. Weith, & M. Bigelow, Handbook of Plastics 3 (1949) (stating that the plastics industry can be traced to the work of Braconnot of France in 1833 and Professor Schoenbein of the University of Basel, Switzerland, in 1845). This resulted from their discoveries pertaining to cellulose nitrate. Id.

31. FACTS AND FIGURES OF THE U.S. PLASTICS INDUSTRY, supra note 15, at 3; see Nat'l Ocean Policy Study Hearings, supra note 4, at 59 (statement of Roger Manus, President of the Center for Environmental Education) (affirming that shortages of rubber and other materials created a demand for plastics during the World War II).

32. FACTS AND FIGURES OF THE U.S. PLASTICS INDUSTRY, supra note 15, at 13 (showing that the annual plastic resin production in the United States has nearly quadrupled from approximately 14.4 billion pounds in 1967 to 55.7 billion pounds in 1987); see Interagency Task Force, supra note 1, at 38 (stating that the compound growth rate for the U.S. plastics industry for the years 1960-1985 is 8.4% for total production); Weisskopf, Grim Harvest, supra note 18, at 61 (noting that the plastics industry occupies a major role in the United States economy, employing over one million workers).


34. Weisskopf, Grim Harvest, supra note 18, at 61; see FACTS AND FIGURES OF THE U.S. PLASTICS INDUSTRY, supra note 15, at 19 (stating that plastic shipments for the United States in 1987 were valued at more than 23 billion dollars).
year nearly doubled the combined production of the steel, aluminum, and copper industries.\textsuperscript{35} The Society for the Plastics Industry projects that demand for plastics in the United States will increase to 76 billion pounds by the year 2000.\textsuperscript{36}

Fishing gear such as ropes and netting are now almost exclusively fabricated from synthetic materials that resist disintegration when discarded in the marine environment.\textsuperscript{37} Plastics are more durable than wood and rubber, lighter than metals, and less dangerous than glass.\textsuperscript{38} Consequently, plastics continue to replace consumer and industrial products previously manufactured from degradable materials, and constitute an increasingly larger proportion of debris found in marine waters and on coastal shores.\textsuperscript{39} Recent scientific breakthroughs promise to bring even more uses for plastics in the decades ahead.\textsuperscript{40}

Sources of plastic marine pollution are widespread and international

\textsuperscript{35} Hearings on Controlling and Reducing Pollution from Plastic Waste, supra note 1, at 319 (testimony of the Entanglement Network Coalition). In 1987, the manufacture of miscellaneous plastic products represented the fourth largest manufacturing industry in the United States, following petroleum refining, motor vehicle and car body manufacturing, and motor vehicle parts and accessory manufacturing. FACTS AND FIGURES OF THE U.S. PLASTICS INDUSTRY, supra note 15, at 21. The plastics industry also employed more than one million workers throughout the United States in 1987. Id. at 8. In 1984, the United States plastics industry produced more than 17 billion plastic bottles and nearly 1 billion pounds of plastic trash bags. Nat'l Ocean Policy Study Hearings, supra note 4, at 59 (statement of Roger McManus, President of the Center for Environmental Education).

\textsuperscript{36} PLASTICS: A.D. 2000, supra note 28, at 10 (projecting a 3.1 \% growth rate from the 48 billion pounds of plastics demanded in 1985).

\textsuperscript{37} See INTERAGENCY TASK FORCE, supra note 1, at 43-45 (stating that synthetic fishing nets and lines made principally from polyamide (nylon), polyethylene, and polypropylene almost completely replaced natural-fiber based materials by the late 1960s). Strength, durability, buoyancy, light weight, and lower costs are the principal reasons for the change to synthetic nets over previous materials of cotton, linen, hemp, manila, and sisal. Uchida, \textit{The Types and Estimated Amounts of Fish Net Deployed in the North Pacific}, in WORKSHOP ON MARINE DEBRIS, supra note 29, at 27.

\textsuperscript{38} Weisskopf, \textit{Grim Harvest}, supra note 18, at 61; see Johnson, \textit{An SPI Overview of Degradable Plastics}, in PROCEEDINGS OF SYMPOSIUM ON DEGRADABLE PLASTICS (June 10, 1987) [hereinafter PROCEEDINGS ON DEGRADABLE PLASTICS] (stating that lightness, inertness, safety, permanence, and economics are the properties responsible for the increased use of plastics).

\textsuperscript{39} See Interagency Task Force, supra note 1, at 38 (stating that the EPA estimates that plastic constitutes 7.2 \% of municipal solid waste); ENVIRONMENTAL DEFENSE FUND, \textit{To Burn or Not to Burn: The Economic Advantage of Recycling Over Garbage Incineration for New York City} 25-26 [hereinafter \textit{To Burn or Not to Burn}] (indicating that plastics represent 7.4 \% of the solid waste stream in New York City). In Europe, estimated domestic waste in 1986 totaled 100 million metric tons, of which plastics constituted approximately 7 \%. Degradable Plastics in Europe, in PROCEEDINGS ON DEGRADABLE PLASTICS, supra note 38, at 4.

\textsuperscript{40} See Manheim, supra note 23, at 71 n.2 (discussing advances in plastics technology that may lead to plastics capturing an even greater portion of the 100 billion container-per-year market for food packaging).
in nature. These sources of debris can be divided into two categories: debris from ocean sources and debris with land-based origins. Ocean sources generally include a variety of vessels and off-shore facilities. This category is considered the primary contributor to marine plastics pollution. Land-based sources of plastic pollution include: plastic manufacturing and processing activities, sewer overflows and waste treatment plants, solid waste management practices, and littering in coastal areas by the general public.

41. See Trash on America’s Beaches, supra note 1, at 2-1 to -21 (app. 2) (documenting plastic debris collected from beaches in the United States during Coastweeks ’88 that originated from more than 46 different countries).

42. See Interagency Task Force, supra note 1, at 41 (discussing sources of marine debris in terms of ocean and land-based sources); Pruter, supra note 2, at 305 (stating that shipping, rivers, drainage systems, and litter from beach visitors are the major inputs of plastic pollution).

43. See Interagency Task Force, supra note 1, at 42-52 (listing fishing activities, merchant shipping, recreational vessels, military and research vessels, passenger ships, offshore petroleum platforms, and supply vessels as sources of sea-based plastics pollution); see also Plastics in the Ocean, supra note 10, at 19-29 (discussing ocean sources of plastic pollution).

44. See Plastics in the Ocean, supra note 10, at vii (stating that ocean sources are the primary contributors to plastics pollution). But see Kindt, Solid Wastes and Marine Pollution, 34 Cath. Univ. L. Rev. 37, 95 (1984) (stating that marine pollution through solid wastes are primarily attributable to land-based sources).

45. Interagency Task Force, supra note 1, at 52-53. Petrochemical plants convert chemicals into raw plastic pellets. Id. Plastic pellets are transported in bulk by either train, car, or ship, in 50-100 pound bags. Id. Both manufacturing operations and processing facilities use wastewater processes that could lead to discharges of pellets into waterways. Id. at 53. Pellets may also be released during shipping operations by train, truck, or ship. Id. Raw plastic pellets are traded both domestically and internationally. Pruter, supra note 2, at 307. Heavy concentrations of plastic pellets in the vicinity of plastic processing industries indicate that the plastics are carried to sea by river systems. Id.

46. Interagency Task Force, supra note 1, at 53-56. Sewage treatment plants that have insufficient capacity, breakdown facilities, or receive storm water that exceeds the plant’s capacity in combined sewage and storm water run-off systems are all potential sources of plastics pollution. Id. at 54. Unknown quantities of sewage and plastics bypass treatment in these situations and are released into the marine environment. Id. Plastics associated with sewage facility discharges are primarily plastic tampon applicators, condoms, pieces of plastic sheeting, and disposable diapers. Plastics in the Ocean, supra note 10, at 28.

47. Interagency Task Force, supra note 1, at 56. Plastics may be inadvertently released from coastal landfills and from losses of debris during shiploading and overwater transport. Id. For example, the Fresh Kill landfill on Staten Island in New York receives seven hundred tons of trash daily. Plastics in the Ocean, supra note 10, at 29. Plastics frequently blow into surrounding waters and are lost during barge loading operations. Id. Following a 1979 lawsuit by the Town of Woodbridge against New York City, the state of New Jersey and New York City signed a consent decree that requires New York City to install “superboons” and hydraulic cranes to prevent the spilling of garbage. Plan to Prevent Garbage Pollution of the New Jersey Shore, 19 Mar. Pollut. Bull. 152 (1988).

48. See Interagency Task Force, supra note 1, at 52-58 (quoting a survey of
The centuries-old maritime tradition of disposing ship garbage at sea posed little problem to the marine environment until the advent of modern plastic. The National Academy of Sciences estimates that ocean sources dispose of nearly 6.4 million tons of trash into the marine environment annually. Forty-five thousand tons of this trash is plastic. The merchant shipping industry is estimated to dispose of more than 5.7 million tons of litter into marine waters each year.

39.5 miles of beach in Massachusetts that attributed 40% of the debris to beach visitors; Plastics in the Ocean, supra note 10, at 27-29 (quoting studies showing that Los Angeles County beach-goers leave behind roughly 75 tons of trash weekly).

49. See supra note 5 (discussing the tradition of discharging wastes at sea). In written testimony before Congress, Ernest J. Corrado, President of the American Institute of Merchant Shipping, stated:

Historically, commercial merchant vessels have disposed of their garbage at sea in compliance with existing laws. Generally, aboard merchant vessels on the high seas, wastes generated as a result of vessel operations and dock maintenance is disposed of directly overboard. Any of these materials which are non-plastic will sink or degrade in a short time. Wastes generated from the vessel's hotel areas (i.e. galley, crew accommodations, crew lounges, and dining rooms) are normally stored in sealed drums and placed in a garbage stowage area. The garbage is then discharged at sea through a disposal chute from the garbage stowage area or from the stern of the vessel. This must be done at regular intervals since garbage retained on board can quickly become unsanitary and even present a fire hazard. It is common to have birds, marine mammals and fish follow vessels on their voyages to take advantage of these discharges.


50. NAS, Assessing Potential Ocean Pollutants, supra note 6, at 422.

51. Id.

52. Id. Surveys indicate that over 26% of wastes from merchant vessels are nonbiodegradable. Horsman, supra note 7, at 168. Wastes from merchant ships include crew-generated domestic wastes and cargo-associated wastes such as dunnage, shoring pallets, wires, and plastic sheeting. Pruter, supra note 2, at 305, 306. According to the NAS study, merchant ships are the largest contributor of marine debris. NAS, Assessing Potential Ocean Pollutants, supra note 6, at 422. The NAS Study used 1971 data on the number of merchant vessels over 1,000 tons. U.S. Coast Guard, Environmental Assessment for Proposed Regulations for the Prevention of Pollution by Garbage from Ships Under MARPOL 73/78 Annex V Regulations 4 (1988) (Draft submitted to the Environmental Protection Agency on file at the office of the American University Journal of International Law & Policy) [hereinafter Environmental Assessment]. Between 1971 and 1985 the size of the world merchant fleet increased by 27.7%, suggesting an even higher rate of refuse generation than indicated in the 1971 NAS Study. Id. Cargo freighters, replaced with container ships, bulk carriers and tankers, have declined 8%. Id. Cargo-associated wastes generated per ton of cargo in general bulk cargo freighters are 80 to 200 times greater than waste from container vessels. Id. Thus, changes in fleet composition may be offsetting the increase in merchant fleet size. Id.

Merchant marine traffic in United States waters is considerable. Regulatory Evaluation of Annex V, supra note 6, at 2-2 to -26. Records of the United States Maritime Administration (MARAD) show that as of March 1, 1987, a total of 814 vessels of 1,000 tons or more were registered in the United States. Id. at 2-8. Of these, 265 are United States-owned and in noncommercial service, thereby exempt from
Commercial fisheries in the United States are reported to dispose of roughly 245 tons of plastic material into the oceans annually. Other generators of plastics pollution at sea include military vessels such as the United States Navy, passenger ships, recreational vessels, and MARPOL Annex V. The United States Coast Guard inspects 2,789 ocean-going vessels under 1,000 tons. These vessels are likely to operate beyond three miles of shore and include: 54 freight ships, 15 tank ships, and 2,789 passenger vessels. According to MARAD, United States companies owned 404 foreign-flagged ships as of January 1, 1987. The United States Coast Guard inspected 6,751 foreign vessels from 110 shipping nations on call at United States ports in 1987.


The Coast Guard's Regulatory Evaluation converts estimates of ship-generated garbage to garbage bag equivalents using a thirty gallon garbage bag projected to hold 4.01 cubic feet of plastic waste. Regulatory Evaluation of Annex V, supra note 6, at 4-9. Vessels over 1,000 tons during a typical voyage are estimated to generate between 29 and 60 garbage bags of waste, 18 to 39 bags of which is plastic waste. Id. at 4-11. Large passenger vessels are estimated to generate 115 garbage bags of waste, 74 bags of which are plastic waste. Id. Tugboats and tow boats are projected to generate five garbage bags of waste, three bags of which may be plastic waste. Id.

Parker & Yang, Development of Methodology to Reduce the Disposal of Non-degradable Refuse into the Marine Environment (unpublished manuscript presented at the Sixth International Ocean Disposal Symposium, Apr. 21-25, 1986, Pacific Grove, California), cited in Interagency Task Force, supra note 1, at 47. In 1985, the United States domestic fishing industry consisted of 129,800 fishing craft and 238,800 fishermen. Regulatory Evaluation of Annex V, supra note 6, at 2-29. Of these vessels, 24,300 or 18.7% weigh five tons or more. Id. Boats in the 5 to 25 ton range are estimated to produce roughly 6 bags of wastes, 4 of which may be plastic waste; middle sized ships generate approximately 17 bags of plastic waste. Id. at 4-15. The largest vessels, over 1,000 gross tons, could generate up to 221 garbage bags of plastic garbage per voyage. Id. at 4-15. Fishing vessels represent the largest number of commercial vessels in the United States affected by MARPOL Annex V. Id. at 2-26. Lloyd's Register lists 20,974 fishing boats worldwide. Lloyd's Register of Shipping, supra note 52, at 12.

See Interagency Task Force, supra note 1, at 49 (stating that the U.S. Navy employs nearly 285,000 people on board its approximately 600 vessels that operate around the world and discharge approximately four tons of plastic into the oceans on an average day). A survey of one Navy vessel indicated that plastics represented 6.7% of the total waste stream. Regulatory Evaluation of Annex V, supra note 6, at 4-7 (citing a survey conducted by Koss and Mullenhard in 1988).

NAS, Assessing Potential Ocean Pollutants, supra note 6, at 422 (estimating that passenger ships serving United States ports dispose of approximately 28,000 tons of trash annually). But see Regulatory Evaluation of Annex V, supra note 6, at 5-21 to -22 (stating that United States passenger ships weighing over 1,000 tons are largely in compliance with Annex V prohibitions on dumping due to concern for the sensitivities of passengers and the convenience of port disposal). The 2,720 passenger vessels under 1,000 tons registered with the U.S. Coast Guard in 1987 are mainly ferries or charter fishing boats that do not make extended trips to sea. Id. at 2-15. Lloyd's Register lists 3,870 ferries and passenger vessels. Lloyd's Registry of Shipping, supra note 52, at 12.

See Plastics in the Ocean, supra note 10, at 26 (using the methodology of the NAS study for calculating waste generation and estimating that recreational vessels in 1984 deposited roughly 51,642 metric tons of trash into marine waters). The
off-shore oil activities.67

Plastics in the marine environment include various consumer items, styrofoam, plastic strapping bands and sheeting used by industry, and ropes, line, nets and net fragments used in the fishing industry.68 Plastic "pellets," the raw form of plastic before it is manufactured into consumer items, also contribute to the pollution problem.69 Although the highest concentrations of plastic debris are found near coastal areas, plastics observe no political boundaries and are found in heavy concentrations in areas where winds or currents concentrate them.70

U.S. Coast Guard in 1985 estimated that 9.6 million recreational boats were registered in the United States. REGULATORY EVALUATION OF ANNEX V, supra note 6, at 2-40. Approximately 241,000 recreational vessels operate beyond three miles from shore. Id. at 2-44. An average 16 million recreational vessels sail coastal waters, estuaries, or lower rivers that flow into coastal waters. INTERAGENCY TASK FORCE, supra note 1, at 48. These vessels dispose of various consumer items that pollute the marine environment. Id. 57. See INTERAGENCY TASK FORCE, supra note 1, at 51 (detailing plastic wastes from petroleum-associated industries as including: plastic sheeting, computer write-protect rings, seismic markers, and oil and air filters). The Minerals Management Service (MMS) of the United States estimates that 3,493 production platforms are active in the Gulf of Mexico. REGULATORY EVALUATION OF ANNEX V, supra note 6, at 2-47. Additionally, the U.S. Coast Guard estimates that there are 484 industry service vessels operating under the United States flag on the Outer Continental Shelf and 125 operating in foreign waters. Id. at 2-48. Approximately 124 active mobile offshore drilling units (MODUs) are also operating in federal waters. Id. at 2-46. MMS regulations prohibit the disposal of solid wastes from offshore gas and oil platforms. 30 C.F.R. § 250.40 (1989). The Clean Water Act also limits discharges of solid waste from offshore oil and gas platforms and offshore drilling units by requiring operators in federal waters to obtain National Pollution Discharge Elimination System (NPDES) permits. REGULATORY EVALUATION OF ANNEX V, supra note 6, at 5-6 (citing the Clean Water Act, 33 U.S.C. §§ 1251-1387). Despite these existing prohibitions, however, lost or discarded plastic items from oil industries continue to pollute Texas beaches. See INTERAGENCY TASK FORCE, supra note 1, at 51 (stating that the off-shore petroleum industry contributes significantly to the debris problem in Texas). 58. See Pruter, supra note 2 (discussing the components and types of common plastic debris). 59. See id. at 307, 309 (discussing plastic pellet pollution). Plastic pellets are the raw form of plastic after it is manufactured from polyethylene. Id. Pellets range in size from .1 millimeters to five millimeters and are found on beaches throughout the world. Id. at 308. Near industrial centers in New Zealand, concentrations of more than 10,000 pellets per linear meter of beach are common. Id. at 307. A 1984 study of North Atlantic waters between Cape Cod and Cape Canaveral found concentrations of more than 8,000 pellets per square kilometer of ocean. Id. Similar surveys of beaches in Lebanon showed plastic pellets and styrofoam to be common debris. Id. at 309.

The source of plastic pellet pollution in marine waters is uncertain. See O'Hara, Plastics Debris and Its Effects on Marine Wildlife, in AUDUBON WILDLIFE REPORT 1988/89 395, 411 (1988) (stating that the problem of pellet pollution has not been fully addressed and that it is uncertain whether manufacturing facilities or the shipping and handling of pellets result in their discharge into marine waters). 60. Pruter, supra note 2, at 307. Marine litter is often concentrated along coastlines because merchant marine shipping, fishing, and recreational activities usually occur near the shore. Id. The buoyancy of plastics allow them to be concentrated along
B. Effects of Plastics Pollution on the Marine Environment

Plastic debris exacts a heavy toll on the world’s living marine resources. Each year, through either entanglement and/or ingestion, plastics cause the deaths of tens of thousands of marine mammals, sea turtles, seabirds, and fish. The accumulation of plastics in current-generated rifts intensifies the threat to the environment because marine life also concentrates in these areas. Plastic debris may also threaten entire animal populations.

Among the marine mammals most susceptible to entanglement in lines of convergence between water masses and at the center of major current gyres. Laist, supra note 8, at 323. These same areas are often major feeding grounds for large populations of marine life. Id.; see Day & Shaw, Patterns and Abundance of Pelagic Plastic and Tar in the North Pacific Ocean, 1976-1985, 18 M AR. POLLUT. BULL. 311, 314 (1987) (stating that plastics generated from shipping around Japan move in response to the winds and currents of the North Pacific).

The origins of plastic debris is also testimony to the international nature of the problem. See Heneman, CENTER FOR ENVIRONMENTAL EDUCATION, PERSISTENT MARINE DEBRIS IN THE NORTH SEA, NORTHWEST ATLANTIC OCEAN, WIDER CARIBBEAN AREA, AND THE WEST COAST OF BAJA CALIFORNIA REPORT TO THE MARINE MAMMAL COMMISSION AND THE NATIONAL OCEAN POLLUTION PROGRAM OFFICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DEPARTMENT OF COMMERCE III-7 (1988) [hereinafter PERSISTENT MARINE DEBRIS] (stating that of the 90% of identifiable debris found on Helgoland, a small German island, 39.5% was German, 17.8% was British, 16.5% was Dutch, 9.6% was Danish, and 3.5% was French). A similar one-year survey of a sixty-meter beach in Helgoland, Germany found that plastics constituted 75% of the items found, and that the objects were manufactured in 26 different nations. Vauk & Schrey, Litter Pollution from Ships in the German Bight, 18 M AR. POLLUT. BULL. 316, 316 (1987). A 1986 beach cleanup in Texas recovered a bottle of Bitter Lemon Crush from Great Britain, a shampoo bottle from Denmark, and a dishwashing detergent container from Singapore. Nati’l Ocean Policy Study Hearings, supra note 4, at 47 (statement of Gary Mauro, Texas Land Commissioner).

61. See Plastics in the Ocean, supra note 10, at 30 (noting that plastic waste may be dangerous for entire marine ecosystems as well as for individual marine animals). Bioaccumulation of plastics through the food chain may also be a problem. O’Hara, supra note 59, at 407.

62. See Hearings on Controlling and Reducing Pollution from Plastic Waste, supra note 1, at 320 (statement of the Entanglement Network Coalition estimating that 300,000-700,000 birds and 100,000 mammals die annually from plastic debris).

63. See Carr, Impact of Non-degradable Marine Debris on the Ecology and Survival Outlook of Sea Turtles, 18 M AR. POLLUT. BULL. 352, 352 (1987); (stating that young sea turtles and their food supplies are drawn to ocean convergences, rifts, and driftlines, and that the concentration of buoyant plastic debris in these areas exacerbates entanglement and ingestion problems); see also supra note 60 (discussing the concentration of plastic debris along lines of convergence between water masses).

64. See INTERAGENCY TASK FORCE, supra note 1, at 15 (stating that scientists have identified adverse impacts of plastics pollution on only a few wildlife populations). Marine debris may be a factor in the health of certain endangered, threatened, and commercially valuable species. Id.; see also Plastics in the Ocean, supra note 10, at 30 (stating that entanglement in marine plastics impacts individual animals and may ultimately affect entire ecosystems).
plastic are a great variety of the world's seals and sea lions. Both seals and sea lions exhibit a deadly curiosity for buoyant debris. Entanglements from net fragments and plastic strapping bands used in merchant shipping are the most frequently observed plastics that entangle seals. Although the ultimate effect of plastic debris on animal populations is unclear, studies of depleted northern fur seals completed.

65. Laist, supra note 8, at 320. Numerous seals are vulnerable to entanglement including Antarctic fur seals, New Zealand fur seals, northern fur seals, Hawaiian monk seals, Cape fur seals, northern elephant seals, and California harbor seals. See Bonner & McCann, Neck Collars on Fur Seals, Arctocephalus Gazella at South Georgia, 57 BRIT. ANTARCTIC SURV. BULL. 73 (1982), cited in Manheim, supra note 23, at 78 n.36 (asserting that the Antarctic fur seal is vulnerable to entanglement); Cawthorn, Entanglement in, and Ingestion of, Plastic Litter by Marine Mammals, Sharks, and Turtles in New Zealand Waters, in WORKSHOP ON MARINE DEBRIS, supra note 29, at 336 (examining the vulnerability of the New Zealand fur seal to entanglement); Fowler, Marine Debris and Northern Fur Seals: A Case Study, 18 MAR. POLLUT. BULL. 326, 333 (1987) (estimating that 15% of the young northern fur seals in the Pribilof Islands die a debris-related death); Henderson, A Review of Hawaiian Monk Seal Entanglement in Marine Debris, in Workshop on Marine Debris, supra note 29, at 326 (explaining that Hawaiian monk seals are vulnerable to entanglement); Shaughnessy, Entanglement of Cape Fur Seals with Man-Made Objects, 11 MAR. POLLUT. BULL. 332 (1980) (discussing the entanglement problem relating to the Cape fur seal); Stewart & Yochem, Entanglement of Pinnipeds in Synthetic Debris and Fishing Net and Line Fragments at San Nicolas and San Miguel Islands, California, 1978-1986, 18 MAR. POLLUT. BULL. 336, 338 (1987) (reporting the entanglement of thirty-six northern elephant seals and reviewing the entanglement of Californian harbor seals).

66. See Laist, supra note 8, at 320 (noting that synthetic debris has entangled both California sea lions and Stellar sea lions). Between 1984 and 1986, sixty-nine California sea lions were reportedly entangled in synthetic materials at San Nicolas and San Miguel Islands in the Pacific. Stewart and Yochem, supra note 65, at 338; see also Calkins, Stellar Sea Lion Entanglement in Marine Debris, in WORKSHOP ON MARINE DEBRIS, supra note 29, at 308 (documenting the incidence of Stellar sea lion entanglement in closed plastic packing bands and netting).

67. See Laist, supra note 8, at 323 (noting that marine mammals may view plastic debris as an object of curiosity or play). These animals may also become attracted to and entangled in plastic debris by attempting to pluck fish already snared in the debris. Id.; see also Calkins, supra note 66, at 312 (noting that curiosity and attempts to remove trapped fish may cause sea lions to become entangled in synthetic debris).

68. PLASTICS IN THE OCEAN, supra note 10, at 31; see Laist, supra note 8, at 320 (stating that entanglement in lost or discarded gillnets, trawl nets, and strapping bands are probably the greatest threats to marine mammals). During commercial harvests on the Pribilof Islands from 1981 to 1984, 403 entangled northern fur seals were observed; of these, 268 seals were entangled in net fragments, 84 were entangled in plastic packing bands, and 51 were entangled in other debris such as rope, string, monofilament line, rubber bands, and six-pack holders. Id.

69. PLASTICS IN THE OCEAN, supra note 10, at 31. Although plastic injuries to many species of marine life are well documented, scientists have identified the impact upon only a few wildlife populations, such as the northern fur seals and endangered Hawaiian monk seals; see INTERAGENCY TASK FORCE, supra note 1, at 14, 15 (stating that although it is known that marine debris affects many endangered, threatened, and commercially valuable species, a considerable amount of additional data is needed to determine adverse impacts on entire populations).

70. See 53 Fed. Reg. 17,888 (May 18, 1988) (announcing that effective June 17,
clude that entanglement is a major contributor to the seals' four to eight percent annual population decline. An estimated 40,000 northern fur seals die each year from entanglement in plastic. Increased plastics pollution is suspected in similar population declines of other seal species.

Other species of marine life, such as whales and dolphins, are also victims of plastic pollution through entanglement and ingestion. Whales, in particular, are often reported dragging great lengths of synthetic lines and fishing gear. Sea turtles of all kinds are susceptible to entanglement in plastic. Even more devastating is the propensity of sea turtles to ingest plastic pellets and garbage bags mistaken for jellyfish or other food.

1988, the northern fur seal is a "depleted" species under the Endangered Species Act).

72. Weisskopf, Grim Harvest, supra note 18, at 61.
73. See Manheim, supra note 23, at 78 n.40 (stating that studies of Stellar sea lion and Hawaii monk seal populations indicate plastic debris may be accountable for population declines).
74. See INTERAGENCY TASK FORCE, supra note 1, at 20 (stating that observers throughout the world have reported incidents of whales and dolphins entangled in net fragments and other fishing gear).
75. See PLASTICS IN THE OCEAN, supra note 10, at 41 (quoting Smithsonian Institution of Natural History records documenting whale ingestion of plastic bags). These records indicate that Gervais beaked whales, Cuvier's beaked whales, Dwarf sperm whales, Pygmy sperm whales, Sperm whales, and Mink whales have all ingested plastic bags. Id. An autopsy performed on a beached Pygmy sperm whale that died after eleven days in captivity revealed that death was attributable to infections from a 30-gallon plastic garbage can liner, a plastic bread wrapper, and a corn chip bag found in the calf's stomach. Weisskopf, Grim Harvest, supra note 18, at 64.
76. See Laist, supra note 8, at 319, 320 (stating that in waters off the northeast Coast of the United States, between 1975 and 1986, 20 Humpback whales, 15 Mink whales, and 10 Right whales were observed entangled in lines from lobster pots or gill nets). It is not clear whether these entanglements are the result of active or derelict gear. Id. A detailed account of the individual trauma and dangers of entanglements to whales can be found in the report of Dr. Stormy Mayo, director of the Massachusetts based Cetacean Research Program, who worked over a 47-day period in 1985 to free Ibis, a Humpback whale entangled off the New England coast. Fellow Travelers, 12 CALYPSO LOG 17 (1985). A similar rescue of a Gray whale entangled in gill netting occurred one month later in the Pacific Ocean, and nearly took the life of a diver. Id. at 18, 19.
77. Carr, supra note 63, at 352.
78. Id. at 355, 356. Drifting turtle hatchlings often come into contact with large quantities of plastic debris, which they fatally mistake for food. Id. Leatherbacks, in particular, show a propensity to ingest plastic sheeting mistaken for jellyfish. Id. During Coastweeks '88, volunteers found a dead Green turtle entangled in fishing gear on a Florida beach and a dead Leatherback on a Maine beach that had ingested a plastic garbage bag. TRASH ON AMERICA'S BEACHES, supra note 1, at 29; see Sadowe & Morreale, Marine Mammal and Sea Turtle Encounters with Marine Debris in the New York Bight and Northeast Atlantic (presented at the Second International Conference
A great variety of sea birds ingest plastic\textsuperscript{79} and are susceptible to entanglement in synthetic debris. Young birds often fatally ingest plastic particles or pellets that the parents have ingested and regurgitated.\textsuperscript{80} Entanglement in discarded fishing gear, six-pack rings, and monofilament line can lead to drowning, choking, and starvation.\textsuperscript{81} Observations in the German Bight indicate that plastics are responsible for up to twenty-six percent of Gannet mortality rates.\textsuperscript{82} Active Japanese salmon nets kill an estimated 250,000 seabirds during a two-month fishing season in United States waters.\textsuperscript{83} Similarly, discarded ghost nets continue to capture both target and nontarget fish, ultimately attracting and entangling seabirds.\textsuperscript{84} One drift net retrieved in the North Pacific contained over 350 dead seabirds.\textsuperscript{85} As plastics become increasingly common in ocean waters, many endangered populations of seals,\textsuperscript{86} whales,\textsuperscript{87} porpoises,\textsuperscript{88} turtles,\textsuperscript{89} and birds\textsuperscript{90} will be


79. See Day, Wehle & Coleman, Ingestion of Plastic Pollutants by Marine Birds, in WORKSHOP ON MARINE DEBRIS, supra note 29, at 346, 378 (noting that 50 of the world’s 250 species of sea birds ingest plastic debris). It is suspected that birds confuse plastic for fish eggs and/or larvae that are similar in size and color. Laist, supra note 8, at 21. Ingestion appears most common in albatrosses, petrels, shearwaters, phalaropes, puffins, and auklets. Id. Ingestion may reduce feeding drives, block digestive systems, and/or damage stomach linings. Id. at 319. A study of the Laysan albatross showed that up to 90% of the birds studied had ingested plastic. Hearings on Controlling and Reducing Plastic Waste, supra note 1, at 319-20 (testimony of the Entanglement Network Coalition, presented by Albert M. Manville II, Chairman and Senior Staff Wildlife Biologist, Defenders of Wildlife).

80. INTERAGENCY TASK FORCE, supra note 1, at 23; see Van Franeker & Bell, Plastic Ingestion by Petrels Breeding in Antarctica, 19 MAR. POLLUT. BULL. 672 (1988) (documenting ingestion of plastics by young Southern Fulmar, Cape Petrel, Antarctic Petrel, and Wilson’s Storm Petrels). “User plastics” constituted 73% of the plastic ingested. Id. Wilson’s Storm Petrels had a mean of 4.4 plastic particles per bird with 16 particles found in the stomach of one chick. Id. The plastic may cause reduced food intake and increase body pollutants. Id. at 674.

81. INTERAGENCY TASK FORCE, supra note 1, at 21; see Weisskopf, Grim Harvest, supra note 18, at 63, 64 (describing the plight of brown pelicans in Florida that become entangled in plastic fishing line that later snags mangrove trees, a traditional roost for the birds).

82. Vauk & Schrey, Records of Entangled Gannets (Sula bassana) at Helgoland, German Bight, 18 MAR. POLLUT. BULL. 350, 351 (1987).

83. PLASTICS IN THE OCEAN, supra note 10, at 34.

84. Id.

85. Jones & Ferrero, Observations of Net Debris and Associated Entanglements in the North Pacific Ocean and Bearing Sea, in WORKSHOP ON MARINE DEBRIS, supra note 29, at 213. In 1978, ninety-nine seabirds were recovered from a 15 kilometer abandoned drift net. Laist, supra note 8, at 321. It is likely that additional seabirds decompose and drop from such nets before they are recovered. Id.

86. See supra note 70 (regarding the official listing of the northern fur seal as a
pushed closer to extinction.

C. ECONOMIC IMPACTS OF MARINE PLASTICS POLLUTION

Plastics pollution in the marine environment imposes heavy economic burdens on individuals, industries, and governments throughout the world.\textsuperscript{91} Plastics in marine waters impact commercial fishing stocks,\textsuperscript{92} damage sea vessels,\textsuperscript{93} and require governments to incur heavy beach cleanup costs.\textsuperscript{94} In addition, plastic debris affects property values\textsuperscript{95} and coastal tourism.\textsuperscript{96}

Plastics in the marine environment kill large numbers of fish and compete with ongoing commercial fisheries for fish stocks.\textsuperscript{97} Nets once

\textsuperscript{91} Interagency Task Force, supra note 1, at 15. The seals are listed as an endangered species. 50 C.F.R. \S 17.11(h) (1988).

\textsuperscript{92} See Hearings on Controlling and Reducing Plastic Wastes, supra note 1, at 320 (statement of the Entanglement Network Coalition) (listing endangered whales as threatened by persistent debris). Whales listed as endangered or threatened include: blue, bowhead, finback, gray, humpback, right, sei, and sperm. 50 C.F.R. \S 17.11(h) (1988). A Bering Sea Beaked whale, one of the rarest whales in the world, washed ashore dead with a plastic bottle cap and a chunk of rubber in its stomach. Rare Whale Beached in USA, UNEP News, May-June 1986, at supp. 4, cited in Manheim, supra note 23, at 80. The species has been sighted only a few dozen times. Id.

\textsuperscript{93} The critically endangered West Indian manatee is also threatened by marine plastics through both ingestion and entanglement. See Center for Environmental Education, Marine Wildlife Entanglement in North America 72-75 (1986) [hereinafter Marine Wildlife Entanglement in North America] (documenting incidents of manatee entanglements and ingestion off the coast of Florida); see also 50 C.F.R. \S 17.11(h) (1988) (listing the West Indian (Florida) manatee as endangered).

\textsuperscript{94} See Hearings on Controlling and Reducing Plastic Waste, supra note 1, at 320 (testimony of the Entanglement Network Coalition) (citing the threat of plastic debris to critically endangered Gulf of California harbor porpoise).

\textsuperscript{95} Interagency Task Force, supra note 1, at 23. Green, loggerhead, kemp's ridley, and hawksbill turtles, are known to ingest plastic, and are listed as threatened or endangered under the Endangered Species Act. Id.; see 50 C.F.R. \S 17.11(h) (1988) (listing endangered and threatened sea turtles).

\textsuperscript{96} See Marine Wildlife Entanglement in North America, supra note 87, at 170 (listing the brown pelican as an endangered species that often interacts with and is threatened by marine plastic debris); see also 50 C.F.R. \S 17.11(h) (1988) (listing the brown pelican among endangered sea birds).

\textsuperscript{97} See infra notes 97-114 (discussing the economic impacts of plastics pollution).
made of cotton and other biodegradable materials that quickly disintegrated in salt water\textsuperscript{98} are now almost exclusively constructed with synthetic materials.\textsuperscript{99} The North Pacific salmon and squid fisheries of Japan, Taiwan, and the Republic of Korea set out an estimated 21,300 kilometers of drift net each night.\textsuperscript{100} The North Pacific drift net fisheries are estimated to introduce approximately 1,624 miles of derelict fishing net into the Pacific each year.\textsuperscript{101} Synthetic fishing nets that are lost or thrown overboard in the marine environment remain strong enough to trap fish and wildlife for an estimated six years.\textsuperscript{102} Thus, ghost nets may deplete marine resources for years by ensnaring fish and thereby attracting predators that also become entangled.\textsuperscript{103} In 1974, lost or discarded lobster traps off the coast of New England, primarily constructed with synthetic netting, accounted for an estimated annual loss of over 1,420,000 pounds of lobster valued at over \$248 million.\textsuperscript{104} To minimize the impact of lost gear on its lobster fisheries, the state of Maine now requires a biodegradable vent in all lobster traps.\textsuperscript{105} Similar trap and gear losses occur in other fisheries that are not required to use biodegradable panels.\textsuperscript{106}


\textsuperscript{99} See INTERAGENCY TASK FORCE, supra note 1, at 42-45 (stating that synthetic fishing nets and lines are made principally of polyamide (nylon), polyethylene, and polypropylene and that by the mid-1960s synthetic fibers in large part replaced natural-fiber-based materials). Strength, durability, and lower cost are among the reasons for the change to synthetic nets. Id. In the late 1940s, synthetic fibers replaced natural fibers such as hemp, linen, cotton, and manila in the construction of nets.

\textsuperscript{100} Eisenbud, The Pelagic Driftnet (submitted to the Food and Agriculture Organization World Conference on Fisheries Management and Development, June/July 1984), cited in Fjelstad, supra note 98, at 679 n.9. The impact of lost nets is not well documented, but even a low rate of net loss from a large number of fisheries could eventually produce substantial quantities of net debris. Laist, supra note 8, at 322.

\textsuperscript{101} See INTERAGENCY TASK FORCE, supra note 1, at 28.

\textsuperscript{102} REGULATORY EVALUATION OF ANNEX V, supra note 6, at 3-2.

\textsuperscript{103} ME. REV. STAT. ANN. tit. 12 § 6433-A (1988).

\textsuperscript{104} See High, Some Consequences of Lost Fishing Gear, in WORKSHOP ON MARINE DEBRIS, supra note 29, at 430-31 (reporting that King crab and Dungeness crab fisheries in Alaska lose an estimated 10% of their pots annually). Due to the lack of degradable panels, up to 30,000 lost pots may still be in operating condition and in direct competition with crab fisheries. Id. Hawaiian spiny lobster fisheries lose up to 40% of their pots annually. Hearings on Controlling and Reducing Pollution From Plastic Waste supra note 1, at 165 (testimony of James E. Douglas, Acting Deputy
Plastic debris also commonly foul boat propellers and clog cooling water-intake systems for commercial fishing vessels and recreational boaters. The United States Navy has experienced similar problems from plastic debris. The damage often requires costly repairs and causes needless delays. Foreign vessels report similar problems.

Plastic debris imposes substantial beach cleanup costs on foreign nations as well as state and local governments in the United States. In 1987, after large amounts of debris, including medical waste and garbage, washed onto the shores of New York and New Jersey, the two states spent over $500,000 to clean only fifty-three miles of public beach. Local economies dependent on tourism dollars are particu-
larly vulnerable to the economic impacts of plastic debris.114

II. THE REGULATION OF PLASTICS POLLUTION FROM SHIPS

A. THE INADEQUACY OF PREVIOUS LAW

Annex V of MARPOL is the primary international regime regulating at-sea disposal of ship-generated waste.115 Prior to ratification of Annex V, international law provided little authority regulating incidental plastics pollution from ships. An examination of international dumping conventions, customary international law as embodied in the Law of the Sea Convention, and regional and multilateral agreements reveals that prior international controls did not regulate the disposal of ship-generated solid wastes.116 United States domestic law prior to rati-

114. See Persistent Marine Debris, supra note 60, at IV-20 (stating that following the 1976 "floatables" incident in New York, the local recreational fishing business lost an estimated 30% of its business, restaurants suffered a 20% loss, and beach attendance was down by 30-50%). Local business lost an estimated 30 million dollars as a result of the debris, most of which was plastic. Id. Improper disposal of medical waste and other garbage resulted in an estimated loss of $1.3 billion in tourist income for Long Island business during July and August, 1988. EPA Issues Medical Waste Regulations, 19 Env’t Rep. (BNA) 2463 (Mar. 17, 1989). The debris on Long Island, while attributable to a variety of ocean and land-based sources, are illustrative of the potential impact of plastic debris.

Eighteen of 254 Texas counties border the Gulf of Mexico, but account for more than one-third of the state's 16 billion dollar tourism industry. Hearings on H.R. 940, supra note 49, at 166, 167 (statement of Gary Mauro, Texas Land Commissioner). Despite efforts to clean the beaches of debris, many tourists leave Texas beaches disgusted. Id.; see PLASTICS IN THE OCEAN, supra note 10, at 50 (noting that since the establishment of the Padre Island National Sea Shore in Texas in 1962, 99% of the complaints received concern the beach litter problem). Plastics pollution also threatens New Jersey’s seven billion dollar per year coastal tourism industry. Hearings on Controlling and Reducing Pollution from Plastic Waste, supra note 1, at 49-50.

115. See S. REP. NO. 100-8, 100th Cong., 1st Sess. 18 (1987) [hereinafter S. REP. No. 100-8](statement of Rear Admiral J. William Kime, Chief, Office of Marine Safety, Security and Environmental Protection, U.S. Coast Guard) (stating that MARPOL is the primary international regime aimed at preventing unnecessary and uncontrolled pollution from ships). Annex V is specifically tailored to address the global problem of at-sea disposal of ship-generated garbage. Id.

116. See O’Hara, supra note 59, at 41 (discussing the limits of the London Dumping Convention and the MARPOL Protocol prior to adoption of Annex V); Gosliner, Legal Authorities Pertinent to Entanglement by Marine Debris in WORKSHOP ON MARINE DEBRIS, supra note 29, at 18-19 (noting the limits of the London Dumping
fication of Annex V was similarly incapable of addressing plastics pollution from ships.\textsuperscript{117}

1. International Law

a. The London Dumping Convention

The London Dumping Convention (LDC),\textsuperscript{118} the only dumping convention that the United States is a signatory to, is the most comprehensive international convention on marine waste disposal.\textsuperscript{119} The LDC prohibits the deliberate disposal of dangerous wastes,\textsuperscript{120} including plastics and other persistent synthetic materials, that float or remain suspended in marine waters in a way that may materially interfere with fishing, navigation, and other legitimate uses of the sea.\textsuperscript{121} A license is

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  \item Organohalogen compounds.
  \item Mercury and mercury compounds.
  \item Cadmium and cadmium compounds.
  \item Persistent plastics and other persistent synthetic materials, for example, net-
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required for ocean dumping of other less harmful substances. The stated purpose of the LDC is to promote effective control of all sources of marine pollution. A further purpose of the LDC is the prevention of ocean pollution caused by dumping of waste and other matter that may create hazards to human health, impact on living marine resources, damage amenities, or hinder legitimate uses of the sea. Each contracting party under the LDC must enforce the Convention and exercise jurisdiction over vessels and aircraft which are: first, of that state's registry or flying its flag; second, loading matter to be dumped within the state's territory or territorial seas; and third, vessels and platforms under a member parties' jurisdiction believed to be engaged in dumping.

Despite the strong language banning the dumping of plastics, the LDC does not regulate wastes generated during the normal operation of ships. The LDC expressly permits the disposal of wastes or other

5. Crude oil, fuel oil, heavy diesel oil, and lubricating oils, hydraulic fluids, and any mixtures containing any of these, taken on board for the purpose of dumping.
6. High-level radioactive wastes or other high-level radioactive matter, defined on public health, biological or other grounds, by the competent international body in this field, at present the International Atomic Energy Agency, as unsuitable for dumping at sea.
7. Materials in whatever form (e.g. solids, liquids, semi-liquids, gases or in a living state) produced for biological and chemical warfare.

London Dumping Convention, supra note 118, Annex I. Annex I permits disposal of substances that are rapidly rendered harmless through physical, chemical or biological breakdown provided these materials do not render edible marine organisms unpalatable or endanger the health of humans and domestic animals. Id. at para. 8. Trace contaminants of the substances allowed in Annex I may be discharged subject to Annexes II and III. Id. at para. 9.

122. London Dumping Convention, supra note 118, art. IV(b)-(c). Wastes listed in Annex II (grey list) require special permits, while dumping of all other wastes requires a general permit. Id. Contracting parties to the London Dumping Convention are currently reviewing the classifications and assessment of wastes dumped at sea to remedy inconsistencies and ambiguities within the London Dumping Convention. LDC Black/Grey Lists Reviewed, 19 MAR. POLLUT. BULL. 504 (1988).

123. London Dumping Convention, supra note 118, art. I.

124. Id. art. VII. Placing enforcement authority with contracting states instead of establishing an independent enforcement agency has been criticized on the basis that it permits a party to ignore the London Dumping Convention's requirements. J. KINDT, supra note 119, at 1128. Consequently, much of the protection is subject only to various national measures. Id. Furthermore, the absence of an international authority means large areas of the ocean are outside any real protection. Id.

125. See Gosliner, supra note 116, at 6 (discussing exceptions to dumping of wastes derived from normal operations of ships); see BEAN, United States and International Authorities Applicable to Entanglement of Marine Mammals and Other Organisms in Lost or Discarded Fishing Gear and Other Debris, Report to the Marine Mammal
matter incidental to, or derived from the normal operation of vessels.\textsuperscript{126} This broad exception in the LDC permits deliberate disposal of ship wastes such as packaging materials from merchant ships or synthetic fishing gear from fishing vessels since such actions are arguably incidental to normal operations.\textsuperscript{127} Consequently, although the LDC provides authority to regulate the deliberate ocean dumping of municipal wastes taken to sea for disposal, it fails to prevent disposal of plastics and other garbage generated in the day-to-day operations of ships.\textsuperscript{128}

b. The United Nations Law of the Sea Convention

The United Nations Convention on the Law of the Sea (LOS Convention)\textsuperscript{129} seeks to establish a uniform law over the use and conservation of marine resources.\textsuperscript{130} The LOS Convention includes provisions...
addressing marine pollution from dumping and vessel sources. The LOS Convention, which has not entered into force, obligates signatory states to "protect and preserve the marine environment." In addition, the LOS Convention requires states individually and/or jointly to take necessary measures consistent with the LOS Convention to prevent, reduce, and control pollution of the marine environment from "any source."

The LOS Convention directs states to pass laws that will prevent, avoid, diminish, and control pollution of the marine environment from ocean dumping. However, similar to the LDC, the LOS Convention defines dumping as "deliberate disposal" and expressly excludes dispo-

131. LOS Convention, supra note 129, pt. I, art. 1, para. 1(4). The LOS Convention defines pollution as:

(4) pollution of the marine environment means the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.

132. Id. pt. XII, sec. 5, art. 210. Article 210 requires states to "adopt laws and regulations to prevent, reduce and control pollution of the marine environment by dumping." Id. para. 1.

133. Id. pt. XII, sec. 5, art. 211. Article 211 requires states to act through a competent international organization to establish international rules to prevent, reduce, and control vessel source pollution. Id. The International Maritime Organization, although not expressly mentioned in article 211, is considered the "competent international organization" governing vessel source pollution. J. KINDT, supra note 119, at 1,174, 1,198.

134. UNITED NATIONS, MULTILATERAL TREATIES DEPOSITED WITH THE SECRETARY-GENERAL, STATUS AS OF 31 DECEMBER 1988, 752, U.N. Sales No. E.89.V.b (1989). Although 159 states have signed the LOS Convention, only 39 states have formally ratified or acceded to the Convention. Id. Sixty nations are required to ratify or accede to the Convention to bring it into force. LOS Convention, supra note 129, Pt. XVII, art. 308.

135. LOS Convention, supra note 129, pt. XII, sec. 1, art. 192.

136. Id. pt. XII, sec. 1, art. 194, para. 1. The Convention directs states to use the most practical means available and those that they are capable of exercising to prevent, reduce, and control marine pollution from land-based sources, from the atmosphere, and from vessel dumping. Id. at paras. 1-3. The regulation of "any source" would appear to include incidental pollution from ships; however, article 194 limits measures to those "consistent with this Convention" and incidental dumping is expressly excluded from the LOS Convention definition of "dumping." Id. art. 1, para. 1(5). See infra note 138 (discussing the exclusion of incidental dumping from the Law of the Sea definition). Additionally, the LOS Convention limits coastal states to enforcing generally accepted international rules established through the competent international organization within their exclusive economic zones. Id. art. 211(4); infra notes 331-37 and accompanying text (discussing the LOS Convention's limitations on coastal state powers within the exclusive economic zone).

137. LOS Convention, supra note 129, pt. XII, sec. 4, art. 210.
sal incidental to normal operations of a vessel at sea.\textsuperscript{138} Disposal of ship-generated garbage is therefore not within the scope of the general prohibition on dumping.\textsuperscript{139}

The LOS Convention also instructs states to establish international rules\textsuperscript{140} and adopt laws governing their own flagships that prevent, reduce, or control pollution from ships.\textsuperscript{141} Under the LOS Convention, coastal states are permitted to adopt and enforce environmental regulations governing all ships within their territorial waters.\textsuperscript{142} Regulation of foreign ships in the Exclusive Economic Zone (EEZ),\textsuperscript{143} however, must

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\item \textsuperscript{138} Id. pt. I, art. 1, para. 1(5)(b). "Dumping" is defined as "(i) any deliberate disposal of wastes or other matter from vessels, aircraft, platforms, or other man-made structures at sea; (ii) any deliberate disposal of vessel, aircraft, platforms or other man-made structures at sea." \textit{Id.} at para. 1(5)(a). Dumping under the LOS Convention does not include: "(i) the disposal of wastes or other matter incidental to, or derived from, the normal operations of vessels, aircraft, platforms, or other man-made structures at sea." \textit{Id.} at para. 1(5)(b)(i).
\item \textsuperscript{139} See J. Kindt, \textit{supra} note 119, at 1138 (stating that article 1, paragraph 1(5)(b) excludes wastes incidental to the normal operations of vessels from the definition of dumping).
\item \textsuperscript{140} LOS Convention, \textit{supra} note 129, pt. XII, sec. 4, art. 211, para. 1. This paragraph directs states acting through the competent international organization or general diplomatic conference to establish "international rules and standards to prevent, reduce, and control pollution of the marine environment from vessels." \textit{Id.}
\item \textsuperscript{141} \textit{Id.} art. 211, para. 2. Unilateral actions of states to prohibit plastics pollution from ships under their flag, however, will not provide the universal regime necessary to reduce the potential harm to marine resources. \textit{See supra} note 60 (discussing the ubiquitous nature of marine plastics pollution).
\item \textsuperscript{142} LOS Convention, \textit{supra} note 129, pt. XII, sec. 4. \textit{Id.} art. 211, para. 4. "Coastal States may, in the exercise of their sovereignty within their territorial sea, adopt laws and regulations for the prevention, reduction, and control of marine pollution from foreign vessels, including vessels exercising the right of innocent passage." \textit{Id.} The laws may not interfere with the right of such vessels to innocent passage. \textit{Id.} States imposing special requirements regarding vessel pollution that are not in accordance with generally accepted international law must publicize such requirements and notify the International Maritime Organization. \textit{Id.} at para. 3. Under the LOS Convention, states have a right to establish territorial seas of up to 12 nautical miles, measured from the "baseline." \textit{Id.} The LOS Convention defines the "baseline" as the low-water line along the coast as shown on charts the states officially recognize. LOS Convention, \textit{supra} note 129, pt. II, sec. 2, arts. 3-5.
\item \textsuperscript{143} See \textit{Id.} pt. V, arts. 55-75 (providing coastal states with sovereign rights over natural resources in a 200-mile Exclusive Economic Zone (EEZ) adjacent to a state's territorial sea). More than 100 states have claimed jurisdiction over the EEZ or similarly labelled zone. Weisburd, \textit{Customary International Law: The Problem with Treaties}, 21 \textit{VAND. J. TRANS. L.} 1, 18-19 (1988). The International Court of Justice (ICJ) has ruled that the concept of a 200-mile zone has become customary international law. \textit{Id.} (citing Case Concerning the Continental Shelf (Tunisia v. Libya), 1982 I.C.J. 18, 74 (Judgment of Feb. 27, 1982); see also Presidential Proclamation on the Exclusive Economic Zone of the United States, Proclamation No. 5030, 48 Fed. Reg. 10,605 (1983) (proclaiming jurisdiction over the EEZ). In 1983, President Reagan proclaimed United States jurisdiction over the Exclusive Economic Zone of the United States, which extends 200 nautical miles from the baseline of United States territorial seas. \textit{Id.}
give effect to generally accepted international rules and standards.\textsuperscript{144} Thus, even if the LOS Convention is viewed as the best evidence of customary international law,\textsuperscript{145} absent an international convention or conference under the auspices of the IMO, the LOS Convention does not establish independent duties pertaining to the disposal of ship-generated wastes.\textsuperscript{146}

The LOS Convention, however, gives legitimacy to global efforts to control marine plastics pollution by directing states to cooperate in conserving living marine resources and requiring them to protect and preserve the marine environment.\textsuperscript{147} The LOS Convention encourages states to develop domestic and international rules and regulations to protect the environment, but stops short of providing specific enforceable duties that prevent disposal of incidental plastics wastes from ships.

c. Regional Agreements

Many multilateral regional agreements on marine pollution control negotiated independently or under the auspices of the United Nations Regional Seas Programme\textsuperscript{148} seek to conserve and protect the marine

\textsuperscript{144} LOS Convention, \textit{supra} note 129, pt. XII, sec. 5, art. 211(5). The LOS Convention limits coastal states to enforcing generally accepted international rules established through the competent international organization within their Exclusive Economic Zones. \textit{Id.} Consequently, even if the LOS were ratified prior to ratification of Annex V of MARPOL, which established international rules on vessel source garbage pollution, coastal states under the LOS Convention would have had no international rules to enforce. Arguably, a prohibition on the disposal of ship-generated garbage within their Exclusive Economic Zones would violate customary international law. \textit{Id.}

\textsuperscript{145} See \textit{supra} note 130 (noting that pollution provisions of the LOS Convention are considered customary international law).

\textsuperscript{146} See J. Kindt, \textit{supra} note 119, at 1195-96 (stating that the gravamen of article 211, paragraph 5 of the LOS Convention is to control vessel source pollution in economic zones through enforcement of established IMO regulations). With the exception of ocean dumping or regulation of ice-covered areas, a coastal state may not promulgate stricter regulations than IMO standards within its economic zone. \textit{Id.}

\textsuperscript{147} See United States and International Authorities, \textit{supra} note 125, at 39 (stating that while the LOS Convention does not offer any new basis for resolving entanglement problems, it may be useful in adding force and legitimacy to other efforts); Lentz, \textit{supra} note 128, at 361 (stating that although the LOS Convention does not specifically concede that a marine plastics problem exists, it provides support for the development of domestic laws and addressing global marine pollution problems internationally).

\textsuperscript{148} See generally P. Sand, \textsc{Marine Environmental Law in the United Nations Environment Programme, 24 Natural Resources and the Environmental Series (1988)} (providing a detailed discussion of the United Nations Environmental Programme (UNEP) Regional Seas Programme including the texts of various regional agreements). The UNEP Regional Seas Programme creates 11 regions which include more than 120 of the approximately 130 coastal states in the world. Lentz, \textit{supra} note 128, at 364. UNEP works with states in each region to form "action plans" that outline areas of cooperation and which are incorporated into conventions. \textit{Id.} Under UNEP, regional "action plans" are in place for the eleven regional areas, and
These conventions may obligate states to undertake measures to prevent, abate, and combat pollution from both ocean and land-based sources. Since the problem of plastics pollution is ubiquitous and the geographic areas subject to regional agreements are often limited, such agreements cannot provide the global regime necessary to remedy the international problem of plastics pollution from ships.


See Lentz, supra note 128, at 363 (concluding that regional agreements such as the Oslo Convention, Helsinki Convention, and UNEP Regional Seas Programme offer a promising forum for addressing marine pollution issues). Regional agreements have the advantage of addressing problems beyond the power of individual nations and can tailor provisions to the needs of a specific region. Persistent Marine Debris, supra note 60, at VII-10. Regional agreements can also enter into force when nations in a particular region agree to address pollution problems as a region rather than wait for broad global support. Id.


See supra note 60 (discussing the international nature of plastics pollution).

See Helsinki Convention, supra note 150, (addressing ship-generated wastes, dumping, and land-based sources of marine pollution).

Id. Annex III, reg. 8 (b)(1)(a)(1).
agreement. The ability to avoid disposal in waters subject to regional agreements, coupled with the movement of debris by wind and currents, underscores the limitations of regional agreements in addressing marine plastics pollution.

Other regional agreements, such as the Convention for the Prevention of Marine Pollution By Dumping from Ships and Aircraft (Oslo Convention), concern the dumping of plastics but fail to prohibit the discharge of wastes incidental to ship operations. Many regional agreements do not concern solid waste disposal from ships. Other regional agreements express an intent to conserve and protect marine resources and encourage actions to further such goals.

154. See Persistent Marine Debris, supra note 60, at III-8, VII-11 (stating that in response to the Helsinki Convention's ban on pollution from ships, disposal of trash may occur just before ships enter or just after ships leave the Baltic Sea). According to the Danish Ministry of the Environment, the North Sea entrance to the Baltic and adjacent Danish coast have become problem areas. Id. at III-8.

155. See supra note 60 (discussing the movement and concentrations of plastics pollution).


157. Oslo Convention, supra note 156, Ann. I, para. 6. Article V of the Oslo Convention prohibits dumping of wastes listed in Annex I, including "persistent plastics and other persistent synthetic materials which may float or remain in suspension in the sea, and which may seriously interfere with fishing and navigation, reduce amenities, or interfere with other legitimate uses of the sea." Id. The Oslo Convention prohibits dumping of plastics and synthetic materials in much the same way as the London Dumping Convention. Supra note 121.

158. Oslo Convention, supra note 156, art. 19, para. 1(a). Dumping is defined by the Oslo Convention as "any deliberate disposal of substances and materials into the sea by or from ships or aircraft other than: (a) any discharge incidental to or derived from the normal operations of ships and aircraft and their equipment." Id.

159. See, e.g., The Agreement for Cooperation in Dealing with Pollution of the North Sea By Oil, done at Bonn, June 9, 1969, 704 U.N.T.S. 3 (not yet in force) [hereinafter Bonn Convention]. The Bonn Agreement is the first regional agreement to promote contingency plans for responding to oil spills. WASTES IN MARINE ENVIRONMENTS, supra note 119, at 149.

160. See, e.g., Convention on the Conservation of Antarctic Marine Living Resources, done at Canberra, May 20, 1980, 80 Stat. 271, T.I.A.S. 10,240, reprinted in 19 I.L.M. 841 (1978) (entered into force on Apr. 7, 1982) [hereinafter Canberra Convention]. The Canberra Convention establishes a commission for the conservation of Antarctic marine living resources made up of members from each of the states party to the agreement. Id. art. VII. The commission is charged with facilitating research on conservation needs, compiling data, and formulating conservation measures for the protection of the Antarctic marine environment. Id. The 21 party commission has agreed to maintain records of lost fishing gear, collect derelict marine debris, survey beaches, and maintain an inventory of all netting used in the Convention area. Manheim, supra
Regional agreements may be best suited for regulating and abating land-based sources of plastics pollution. Moreover, regional agreements provide a mechanism for identifying marine pollution problems and developing mitigation plans. Such agreements, however, provide only limited authority for preventing the disposal of ship-generated wastes into the world's oceans.

2. United States Domestic Law

Federal efforts to control marine pollution began roughly two decades ago with the passage of the Marine Protection, Research, and Sanctuaries Act and the Clean Water Act. Prior to the enactment of the Marine Plastic Pollution Research and Control Act of 1987 (MPPRCA), which implements the requirements of MARPOL Annex V, Congress did not provide effective federal authority for regulating ship disposal of incidental solid wastes into marine waters. At least one

161. See Manheim, supra note 23, at 87-88 (stating that a global approach to land-based sources of pollution may not be appropriate and that regional agreements may more effectively address land-based sources of plastics pollution). The Convention for the Prevention of Marine Pollution from Land-Based Sources, done at Paris, Feb. 21, 1974, ST/LEG/SER.B/18 at 547 reprinted in 13 I.L.M. 352 (1974) (entered into force May 6, 1978) is a regional agreement concerned solely with pollution from land-based sources. All the contracting parties to the Oslo Convention except Finland ratified the convention. Persistent Marine Debris, supra note 60, at VII-10. The Paris Convention requires contracting parties to implement programs regarding marine pollution from land-based sources by substances listed in Part I of Annex A. The Paris Convention requires contracting parties to implement programs regarding marine pollution from land-based sources by substances listed in Part I of Annex A. Paris Convention, supra, art. 4. Among the substances to be eliminated are "[p]ersistent synthetic materials that may float, remain in suspension or sink, and which may seriously interfere with legitimate uses of the sea." Id. Annex A, pt. I, para. 4.

162. See Persistent Marine Debris, supra note 60, at VII-12-13 (discussing the Cartagena Convention developed under UNEP, and stating that the action plan and the Convention provide mechanisms for the region to identify issues and plan mitigation for the area).


165. See Hearings on Plastic Pollution, supra note 9, at 3 (testimony of Admiral
law that Congress passed creates an incentive for at sea disposal of ship wastes. The existing laws relevant to marine plastics pollution may be roughly categorized as laws regulating ocean dumping, general pollution control statutes, and fish and wildlife conservation laws.

a. Ocean Dumping

The Rivers and Harbors Act of 1899 (Refuse Act) prohibits the discharge of refuse matter of any kind into waters of the United States, other than refuse flowing from streets and sewers and passing in a liquid state. The Refuse Act does not specifically address persistent plastics pollution, but may be used to prohibit discharges of plastics and other garbage from vessels within the navigable waters of the United States, extending to three miles from shore.

Unfortunately, the limited jurisdictional reach of the Refuse Act and the difficulty of enforcing its criminal provisions against individual polluters restrict the Act's effectiveness. Under the Refuse Act, ships are permitted to freely discard wastes into waters beyond three miles from shore. Vast numbers of international merchant ships, commer-

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John W. Kime, Chief, Office of Marine Safety Security and Environmental Protection, United States Coast Guard) (concluding that the Refuse Act, Federal Water Pollution Control Act, and the Marine Protection, Research and Sanctuaries Act do not adequately address the problem of at sea disposal of ship-generated garbage).

166. See Regualatory Evaluation of Annex V, supra note 6, at 5-9 (stating that the costs associated with foreign ship compliance with the Pest Act provide an economic incentive for foreign ships to discharge ship wastes at sea). The United States Department of Agriculture has delegated broad powers under various pest statutes to its Animal and Plant Health Inspection Service (APHIS), 7 C.F.R. § 2.51 (1989). APHIS requires food wastes from foreign ships to be incinerated or steam-sterilized to prevent the spread of disease and pests. 7 C.F.R. § 330.400 (1988) and 9 C.F.R. § 94.5 (1988). According to 1987 U.S. Department of Agriculture figures, virtually all shipping garbage is dumped at sea, with only 1,731 of the 73,614 ships surveyed off-loading garbage in the United States. Hearings on H.R. 940, supra note 49, at 172 (testimony of Gary Mauro, Texas Land Commissioner).

167. See Regualatory Evaluation of Annex V, supra note 6, at 5-2 (listing legislation influencing ocean disposal and activities); O'Hara, supra note 59, at 412-16 (listing United States legislation relevant to the problem of marine debris and framing the discussion in terms of ocean dumping controls, pollution controls, and laws protecting marine wildlife).


170. See Interagency Task Force, supra note 1, at 92 (stating that the authority to issue permits under the act is now subsumed by the National Pollutant Discharge Elimination System (NPDES) of the Clean Water Act, although the Refuse Act may still be used to prohibit discharges of plastics in United States territorial waters).

171. See generally Plastics in the Ocean, supra note 10, at 84, 85 (discussing the applicability of the Rivers and Harbors Act and concluding that a federal agency could not invoke the Act against individual polluters).

172. See Nat'l Ocean Policy Study Hearings, supra note 4, at 12 (testimony of
cial fishing vessels, and recreational boats operate beyond this distance and are beyond the scope of the Refuse Act.\textsuperscript{173} The Refuse Act does not impose civil fines for violations, but instead carries minor criminal penalties.\textsuperscript{174} Accordingly, the United States Coast Guard, the enforcement agency under the regulations, is not empowered to impose penalties itself.\textsuperscript{176} Instead, it must refer cases to the United States Department of Justice for enforcement actions.\textsuperscript{178} The Coast Guard has described the Refuse Act as not only difficult to enforce, but ineffective in controlling the international problem of ocean plastics pollution.\textsuperscript{177}

The Marine Protection, Research and Sanctuaries Act (MPRSA),\textsuperscript{178} establishes a permit process for the dumping of authorized substances to satisfy the requirements of the London Dumping Convention.\textsuperscript{179} The MPRSA regulates domestic transportation of any material for the purpose of dumping\textsuperscript{180} and prohibits the dumping of any material transported from a location outside the United States into the territorial sea.

Rear Admiral William Kime, United States Coast Guard)(stating that the Refuse Act only prohibits at sea disposal of garbage into the United States territorial sea).

\textsuperscript{173} See REGULATORY EVALUATION OF ANNEX V, supra note 6, at 2-62 (indicating that in 1985, a total of 53,531 United States and foreign vessels entered United States ports from foreign waters). The U.S. Army Corps. of Engineers collects data on “vessel entrances” to determine the level of activity at United States ports. \textit{Id.} at 2-62. A “vessel entrance” is recorded for a United States port when a ship arrives at its first U.S. port of call. \textit{Id.} In 1987, the United States registered numerous ships expecting to travel beyond its territorial waters, including: 814 ocean going vessels of 1,000 tons or more, 2,789 vessels under 1,000 tons, and 129,800 fishing vessels. \textit{Id.} at 2-8 to -28.


\textsuperscript{175} See Hearings on Plastic Pollution, supra note 9, at 95 (statement of Admiral John W. Kime, Chief, Office of Marine Safety Security and Environmental Protection, U.S. Coast Guard) (stating that the Refuse Act of 1899 imposes criminal sanctions requiring prosecution). Admiral Kime testified that “[i]t is very difficult to get the U.S. Attorney to focus on a criminal act for throwing a sack of garbage over the side of a ship when they are faced with many other things, such as drugs, et cetera.” \textit{Id.}

\textsuperscript{176} \textit{Id.}

\textsuperscript{177} \textit{Id.} at 3.


\textsuperscript{180} See Gosliner, supra note 116, at 20 (noting that Congress decided to regulate transportation rather than to explore a direct prohibition on dumping in order to avoid violating principles of international law). The right of a state to exercise jurisdiction over commerce moving from the ports of that state, whether domestic or foreign vessels, is well established in international law. \textit{Id.} Congress thereby concluded that “asserting jurisdiction to regulate transportation by persons subject to the jurisdiction of the United States for the purpose of dumping in the oceans (whether they be high seas or not) attains the same objective as a direct prohibition of dumping without doing violence to principles of international law.” \textit{Id.} (citing S. REP. No. 451, 92d Cong., 2d Sess., reprinted in U.S. CODE CONG. & ADMIN. NEWS 4234, 4246 (1972)); see also PLASTICS IN THE OCEAN, supra note 10, at 91 (stating that transportation is used as a basis for jurisdiction to avoid international conflicts).
or contiguous twelve mile zone. Thus, the dumping of plastics is not permitted. Similar to the London Dumping Convention and the LOS Convention, however, the MPRSA does not prohibit the disposal of wastes incidental to the normal operation of ocean vessels.

The Outer Continental Shelf Lands Act (OCSLA) seeks to support exploration, development, and production of minerals on the Outer Continental Shelf without adversely affecting surrounding waters. Department of the Interior operating regulations promulgated under OCSLA prohibit the disposal of all solid wastes, including plastic, from vessels and structures operating over the Outer Continental Shelf. The prohibitions, however, only apply to a limited number of vessels and structures operating under federal leases. Compliance with even this narrow prohibition is suspect because Texas beaches are overwhelmed with large amounts of plastic debris, much of which is attributed to offshore oil operations.

The Act to Prevent Pollution From Ships (APPS) is the United States implementing legislation for MARPOL. Prior to the incorpor-

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181. MPSRA § 101, 33 U.S.C. § 1411(b) (1982). The United States declaration of a 200 mile EEZ followed the enactment of the MPRSA; Gosliner, supra note 116, at 22. Congressional intent to prohibit dumping within coastal waters under United States jurisdiction apparently extends MPRSA's prohibitions and permit requirements to the 200-mile EEZ limit. Id. Amendments to the MPRSA were introduced in Congress in 1985 and 1986 to extend the jurisdiction of the Act to the 200-mile limit, but Congress failed to act on them. PLASTICS IN THE OCEAN, supra note 10, at 90.

182. 40 C.F.R. § 227.5(d) (1988). The Environmental Protection Agency (EPA) will not issue approval for dumping of persistent, inert synthetic or natural materials that may float or remain suspended in marine waters. Id.

183. See Gosliner, supra note 116, at 20 (stating that MPRSA appears on its face to be inapplicable to disposal of fishing gear or debris from other vessel classes because such materials are not transported with the intent of disposal). It is, however, possible to read a blanket prohibition on the dumping of nondegradable fishing debris into the MPRSA. Id. at 20-22.


185. REGULATORY EVALUATION OF ANNEX V, supra note 6, at 5-5; see 30 C.F.R. § 250.40(b)(6) (1988) (prohibiting at sea disposal of equipment, cables, chains, containers, and other materials).

186. See REGULATORY EVALUATION OF ANNEX V, supra note 6, at 2-47 (stating that roughly 3,493 active production complexes operate in the Gulf of Mexico, 779 of which are manned). Few exist elsewhere in United States waters. Id. The Coast Guard estimates that there are 484 offshore service vessels working within the Outer Continental Shelf. Id. at 2-48.

187. See Hearings on H.R. 940, supra note 49, at 178 (statement of Gary Mauro, Texas Land Commissioner) (indicating that reports show that up to 15% of debris collected on Texas beaches may be attributed to offshore oil operations); REGULATORY EVALUATION OF ANNEX V, supra note 6, at 5-37 (stating that a variety of plastic items common to the oil field operations including gloves, hardhats, plastic wrap and drilling wastes, are regularly found on Texas beaches).

tion of implementing legislation for Annex V, the APPS only regulated the discharge of oil and other hazardous substances into the navigable waters of the United States. Consequently, the APPS did not regulate ship-generated plastic waste.

b. General Pollution Control Statutes

General pollution control statutes also fail to provide adequate authority to address plastics pollution from ships. For example, the Federal Water Pollution Control Act (Clean Water Act) seeks to "restore and maintain the chemical, physical, and biological integrity" of the waters of the United States. Under the Clean Water Act, a National Pollutant Discharge Elimination System (NPDES) permit is required for discharging any pollutant from a point source into navigable waters of the United States. The Clean Water Act's require-

191. See United States v. Ohio Barge Lines, 410 F. Supp. 625, aff'd 531 F.2d 574 (5th Cir. 1975) (holding that the APPS applies only to substances specifically listed as pollutants).
195. FWPCA § 502, 33 U.S.C. § 1362(6) (1982). Under the Clean Water Act, "pollutant" is defined as dredged spoil, solid waste, incinerator residue, sewage, garage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. Id. The problem of plastic ingestion in marine life could arguably bring marine plastics pollution within the definition of "toxic pollutant" as defined below:

[T]hose pollutants, or combinations of pollutants, including disease causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will, on the basis of information, cause death, disease, behavioral abnormalities, cancer, genetic mutations (including malfunctions in reproduction), or physical deformations, in such organisms or their offspring. FWPCA § 502, 33 U.S.C. § 1362(13) (1982).
196. FWPCA § 502, 33 U.S.C. § 1362(7) (1982). Navigable waters are defined as waters of the United States, including the territorial seas that extend three nautical miles from the line of ordinary low tide. Id.; see Hearings on Plastics Pollution, supra note 9, at 3 (testimony of Admiral John W. Kime, Chief, Office of Marine Safety Security and the Environmental Protection, United States Coast Guard) (discussing NPDES permit requirements and noting that the Clean Water Act includes garbage as a pollutant). The Clean Water Act makes disposal without an NPDES permit unlawful. 33 U.S.C. § 1311(a) (1982); supra note 195 and accompanying text (listing garbage as a pollutant under the Clean Water Act). Ships are considered point sources in
ments include disposal of wastes from ships, but the provisions are not enforced.\textsuperscript{197} The Clean Water Act also requires a NPDES permit for pollutant discharges from point sources into the contiguous zone or ocean (i.e. beyond three miles from shore), but specifically exempts vessels and floating crafts.\textsuperscript{198} Plastic debris is not a listed hazardous substance\textsuperscript{199} under applicable regulations, and the Clean Water Act’s hazardous pollutant requirements are not likely to be enforced against ships discharging plastic debris in territorial waters.\textsuperscript{200} Although the Clean Water Act is used to regulate oil platforms\textsuperscript{201} and plastic manufacturing facilities,\textsuperscript{202} it does not adequately address the disposal of plastic and other garbage from ships.\textsuperscript{203}
The Resource Conservation and Recovery Act of 1976 (RCRA)\(^\text{204}\) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund)\(^\text{206}\) also fail to regulate or prohibit ship disposal of plastics and similar debris because plastics are not considered "hazardous" under the acts.\(^\text{208}\) The Toxic Substances Control Act (TSCA)\(^\text{207}\) may offer a vehicle for requiring more readily recyclable or degradable plastics, but TSCA does not regulate waste disposal.\(^\text{208}\) Thus, these statutes primarily regulate toxic and reactive

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John M. Kime, Chief, Office of Marine Safety, Security and Environmental Protection, United States Coast Guard) (stating that the Refuse Act of 1899, the Federal Water Pollution Control Act, and the Marine Protection, Research and Sanctuaries Act do not adequately address the problem of at sea disposal of ship-generated garbage).


206. See PLASTICS IN THE OCEAN, supra note 10, at 96, 100 (concluding that neither RCRA nor CERCLA regulate plastic debris because plastics are not considered hazardous substances under the acts). Plastic debris is probably a solid waste covered by RCRA. Id. at 96. However, solid wastes must be "hazardous" in order for RCRA standards to apply. Id.; F. ANDERSON & D. MANDELKER, supra note 204, at 558 (stating that "[t]he trigger for regulatory action under RCRA is formal designation of a solid waste as hazardous").

CERCLA defines hazardous substance through reference to substances designated as hazardous under the Clean Water Act, Clean Air Act, RCRA, and Toxic Substances Control Act. 42 U.S.C. § 9601(14) (1982 & Supp IV 1986). Marine debris is not a hazardous substance under these statutes, and does not appear to rise to the level of an imminent and substantial endangerment under CERCLA section 104; consequently, the Act is unlikely to apply to plastics pollution. PLASTICS IN THE OCEAN, supra note 10, at 100 (discussing the applicability of CERCLA to the marine debris problem).


208. See INTERAGENCY TASK FORCE, supra note 1, at 97 (stating that under TSCA the EPA could regulate constituent substances of persistent marine debris and determine the advantages of degradable versus nondegradable plastics); see also PLASTICS IN THE OCEAN, supra note 10, at 97 (noting that unlike RCRA, CERCLA, and the Clean Water Act, TSCA does not regulate disposal of debris, but instead regulates chemical substances, thereby enabling the EPA to regulate substances used in plastic manufacturing). Under TSCA, the Administrator of the Environmental Protection Agency may prohibit or regulate the manufacture or distribution of a chemical sub-
substances, not discarded inert plastics from ships.\textsuperscript{209}

c. Fish and Wildlife Conservation Statutes

Wildlife statutes and fisheries laws designed to protect marine fisheries,\textsuperscript{210} endangered species,\textsuperscript{211} marine mammals,\textsuperscript{212} or birds\textsuperscript{213} are essen-

TSCA, 15 U.S.C. § 2605(a) (1988).\textsuperscript{209} See Gosliner, supra note 116, at 24 (stating that the RCRA, similar to the Clean Water Act, lists hazardous substances that are primarily toxic chemicals). RCRA, like other pollution control statutes is primarily designed to regulate toxic and reactive chemicals, and not inert substances such as fishing gear and other debris. \textit{id.} \textsuperscript{210} Magnuson Fishery Conservation and Management Act (FCMA), 16 U.S.C. §§ 1801-1822 (1988). The FCMA seeks, in part, to conserve and manage fishery resources off the coast of the United States. \textit{id.} The Act requires foreign fishermen to obtain a permit to fish within the fishery conservation zone, which is the 200 mile EEZ the United States claims. \textit{INTERAGENCY TASK FORCE, supra note 1, at 94.} Except in cases of emergency or as specifically authorized, regulations under the Act prohibit foreign fishing vessels from intentionally placing into the fishery conservation zone (EEZ) any article, including abandoned fishing gear and plastic items that may interfere with fishing or cause damage to any fishery resource or marine mammal. 50 C.F.R. § 611.12(c) (1988). The ban on discarding wastes, however, is limited to foreign vessels, and does not apply to domestic fishermen. Gosliner, supra note 116, at 28.\textsuperscript{211} Endangered Species Act of 1973 (ESA), 16 U.S.C. §§ 1531-1544 (1988). The purposes of the ESA are to preserve ecosystems on which threatened or endangered species depend and to conserve endangered and threatened species themselves. 16 U.S.C. § 1531(b) (1988). Sea turtles, brown pelicans, East Indian manatees, and certain seal species are among the endangered species plastic marine debris threaten. \textit{Supra} notes 86-90 and accompanying text. The ESA prohibits any person, subject to the jurisdiction of the United States, from “taking” an endangered or threatened species. 16 U.S.C. § 1333 (1988); 50 C.F.R. § 227 (1988). Discharging marine debris that subsequently harms an endangered or threatened species could be considered a violation of the Act, although Federal agencies and the courts have not enforced such an interpretation. \textit{INTERAGENCY TASK FORCE, supra note 1, at 95.} Ownership of the debris, however, must be determined. \textit{id.} \textsuperscript{212} Marine Mammal Protection Act of 1972 (MMPA), 16 U.S.C. §§ 1361-1407 (1988). The MMPA prohibits the taking of marine mammals from waters under the jurisdiction of the United States. \textit{id.} The act prohibits American citizens from taking marine mammals anywhere in the world. \textit{id.} A violation of the Act may occur once discarded debris harms a marine mammal, but again, identification of the owner of the debris is required. \textit{PLASTICS IN THE OCEAN, supra note 10, at 101.} The Fur Seal Act of 1966 (FSA), as amended, makes it unlawful for any person subject to the jurisdiction of the United States to harm fur seals in the North Pacific. 16 U.S.C. § 1152 (1988). The discarding of plastic debris that harms a fur seal may be a violation of the Act, but is subject to the same restrictions limiting the MMPA. \textit{INTERAGENCY TASK FORCE, supra note 1, at 96.} \textsuperscript{213} Migratory Bird Treaty Act (MBTA), 16 U.S.C. §§ 701-712 (1988). The MBTA prohibits the taking of birds protected under the following four treaties: Convention for the Protection of Migratory Birds, Aug. 16, 1916, United States-Great Britain, 39 Stat. 1702 T.S. No. 628; Convention for the Protection of Migratory Birds and Game Mammals, Feb. 7, 1936, United States-Mexico, 50 Stat. 1311 T.S. No. 912; Convention for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment, with Annex, Mar. 14, 1972, United States-Japan, 25 U.S.T.
tially unenforceable against vessels generating plastics pollution.\textsuperscript{214} Although the Fishery Conservation and Management Act\textsuperscript{216} makes it unlawful for foreign fishing vessels to discard fishing gear in the United States' EEZ,\textsuperscript{216} wildlife conservation laws do not generally prohibit ships from discharging wastes at sea.\textsuperscript{217} Ship disposal of plastic debris at sea may entangle, kill, or harm a protected resource and violate a particular wildlife statute.\textsuperscript{218} The spatial and temporal distance from disposal to injury, however, may be so remote and the debris so common that enforcement of wildlife statutes against ships discharging plastics at sea is virtually impossible.\textsuperscript{219}


The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978,\textsuperscript{220} arose from the heightened concern for the marine environment following the Torrey

\textsuperscript{214} See INTERAGENCY TASK FORCE, supra note 1, at 95-96 (examining the Endangered Species Act of 1973, Migratory Bird Treaty Act, and Fur Seal Act of 1976, and concluding that a violation of the acts may occur as a result of a ship discarding persistent debris, but that enforcement is difficult because the debris is hard to trace).


\textsuperscript{216} 50 C.F.R. 611.12(c) (1988). The National Marine Fisheries Service promulgate regulations that prohibit the intentional disposal of abandoned fishing gear and other wastes, such as plastic bags and toxic chemicals, into the fishery conservation zone which may interfere with fishing gear or vessels, or damage fishery resources or mammals. \textit{Id.} The fishery conservation zone extends seaward 200 miles from the baseline of the territorial sea of the United States. 16 U.S.C. § 1821 (1982 and Supp. V 1987); see supra note 210 and accompanying text (discussing the Magnuson Fishery Conservation and Management Act). Bean suggests a similar regulation governing U.S. fishing vessels, which although difficult to enforce without observers, may result in voluntary compliance. United States and International Authorities Applicable to Entanglement, \textit{supra} note 125, at 24.

\textsuperscript{217} See PLASTICS IN THE OCEAN, supra note 10, at 101 (stating that disposal of fishing gear does not generally violate wildlife conservation laws).

\textsuperscript{218} Gosliner, \textit{supra} note 116, at 25. Generally, no violation of wildlife protection laws occurs until an animal is taken; thus, absent a mechanism for identifying the discharger, enforcement of these provisions is nearly impossible. \textit{Id.}

\textsuperscript{219} See Bean, \textit{supra} note 16, at 358 (stating that in practice it is almost impossible to link a particular deliberate or negligent act with the subsequent killing of a protected animal).

\textsuperscript{220} MARPOL Convention, \textit{supra} note 19.
Canyon accident.221 The Convention was signed in London in 1973, but the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973222 modified and procedurally absorbed the parent Convention before its ratification.223 The 1973 MARPOL Convention and 1978 MARPOL Protocol are read as one instrument224 and entered into force on October 2, 1982.225 Under Annexes I and II pertaining to oil and noxious liquid discharges respectively, MARPOL currently regulates more than eighty percent of the world's shipping tonnage.226

The 1978 Protocol227 is the result of the Tanker Safety and Pollution Prevention Conference that convened in London in February 1978 under the auspices of the Intergovernmental Maritime Consultive Or-

221. See Abecassis, Liability for Oil Pollution from Ships, in INT'L MAR. ORG., supra note 19, at 277 (stating that after the April 1967 Torrey Canyon incident, the IMO paid great attention to oil pollution and the international community adopted the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL)).

222. Report on the Act to Prevent Pollution From Ships, supra note 163, at 4,850-51; see UNITED STATES TREATIES IN FORCE, supra note 119, at 323 (noting that the 1978 Protocol incorporates, with modifications, the provisions of the International Convention of Pollution from Ships, signed at London on November 2, 1973).

223. INT'L MAR. ORG. MARPOL 73/78, in FOCUS ON THE IMO 10 (1988). The Convention for the Prevention of Pollution from Ships, 1973, was not in force at the time of the convening of the International Conference on Tanker Safety and Pollution Prevention in 1978 and consequently could not be amended. Id. New measures were thus incorporated into the Protocol. Id. Difficulties concerning Annex II presented problems to early ratification of the MARPOL Convention. Id. As the Conference sought primarily to change Annex I, the Conference decided to adopt changes to Annex I while allowing contracting states to defer implementation of Annex II for three years after the date the Protocol entered into force. Id. This procedure effectively resulted in the Protocol absorbing the parent Convention. Id. States ratifying the Protocol give effect to the Provisions of the 1973 Convention as well, obviating the need to ratify the 1973 Convention. Id. Consequently, the two instruments are read as one and often referred to as MARPOL 73/78. Id.

224. Id.

225. See UNITED STATES TREATIES IN FORCE, supra note 119, at 323 (noting that fifteen states constituting not less than 50 percent of the world's gross merchant shipping tonnage were required to ratify the Convention before it could enter into force).

226. See Coast Guard Commandant Instruction, supra note 20, at enclosure 4 (listing the states party to MARPOL as of February 8, 1989). The parties to MARPOL are: Algeria, Antigua and Barbuda, Australia, Austria, Bahamas, Belgium, Brazil, Brunel Darussalam, Bulgaria, Burma, China, Colombia, Cote d'Ivoire, Czechoslovakia, Democratic People's Republic of Korea, Denmark, Egypt, Finland, France, Gabon, German Democratic Republic, Federal Republic of Germany, Greece, Hungary, Iceland, India, Indonesia, Israel, Italy, Japan, Lebanon, Liberia, Marshall Islands, Netherlands, Norway, Oman, Panama, Peru, Poland, Portugal, Republic of Korea, St. Vincent and Grenadines, South Africa, Spain, Surinam, Sweden, Switzerland, Syrian Arab Republic, Tunisia, Tuvalu, Union of Soviet Socialist Republics, United Kingdom, United States, Uruguay, and Yugoslavia. Id.

227. MARPOL Convention, supra note 19.
Following sixteen oil tanker accidents in and around United States waters during the winter of 1976-77, the United States requested the Conference. The IMCO is a specialized agency of the United Nations concerned solely with maritime affairs. The following section briefly discusses the role of the IMCO (now referred to as the International Maritime Organization or IMO) in establishing international safety and environmental standards for ships.

1. The Role of the International Maritime Organization

Under the auspices of the IMO, member states have approved twenty-one international conventions, adopted more than five-hundred resolutions and set forth numerous codes and guidelines pertaining to marine shipping, safety and the environment. The IMO has implemented rules and adopted protocols regulating ship construction and

228. Report on the Act to Prevent Pollution from Ships, supra note 163, at 4,851. The United States signed MARPOL 73/78 subject to Senate ratification on June 27, 1978. Id. The Senate gave its advice and consent on July 2, 1980. Id.

229. Id. The accidents served as a catalyst for President Carter's March 17, 1977 message to Congress proposing a series of domestic and international measures aimed at reducing pollution from oil tankers. Id. The Conference also established the Protocol of 1978 Relating to the International Convention for the Safety of Life at Sea, 1974, creating stricter safety requirements for vessels. Id. at 4851.

230. Int'l Mar. Org., supra note 19, at 2 (1984). The Convention on the Inter-Governmental Maritime Consultative Organization (IMCO) established the IMCO in 1958. Convention on 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 [hereinafter IMCO Convention]. The IMCO Convention required the acceptance of twenty-one states, including seven with at least one million gross tons of shipping each. Int'l Mar. Org., supra note 19, at 2. The Convention's requirements were fulfilled in 1958 and the first IMCO Assembly met in London in January, 1959. Id. The Convention established the IMCO for the purpose of coordinating and promoting cooperation among governments on matters affecting international shipping and the marine environment. Id. at 3; see IMCO Convention, supra, art. X(a)-iii (stating as objectives marine safety, efficiency of navigation and prevention and control of pollution). The IMO has six bodies that oversee the adoption or implementation of conventions; they are the main organs of the Assembly and Council and the Maritime Safety Committee, Marine Environment Protection Committee, Legal Committee and the Facilitation Committee. Int'l Mar. Org., A Summary of IMO Conventions, in Focus on IMO 4, 5 (1987) [hereinafter Summary of IMO Conventions]. The committees meet more often than the main bodies and are the forum for initial proposals which, if approved, go to the Council and, as necessary, to the Assembly. Id.; see also D. Cusine & J. Grant, The Impact of Marine Pollution 75 (1980) (providing a detailed discussion of the institutional structure of the IMCO and the organization's role in controlling marine pollution).

231. See United States Treaties in Force, supra note 119, at 266. In 1982, an amendment to the IMCO Convention changed its name to the International Maritime Organization (IMO). Id.


The IMO is also responsible for instruments protecting the marine environment. Following the 1967 *Torrey Canyon* oil tanker disaster off the coast of England, the IMO served as a prominent forum for the establishment of international conventions and protocols addressing marine pollution. Subsequent multilateral treaties adopted under the IMO include instruments pertaining to the intervention at sea to respond to pollution threats, liability for oil pollution from ships, and maritime transport and trade.


236. See *Summary of IMO Conventions*, supra note 230, at 16 (discussing IMO’s development of the International Maritime Dangerous Goods Code (IMDG) that regulates the classification, labeling, handling, and packaging of dangerous goods).


239. See *Summary of IMO Conventions*, supra note 230, at 27 (discussing adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978). This Convention established basic training and certification requirements on an international level for seafarers.


241. See *Int’l Mar. Org.*, *supra* note 19, at 277 (discussing various IMO protocols addressing marine pollution); *Summary of IMO Conventions*, supra note 230, at 30-42 (summarizing IMO Conventions pertaining to marine pollution).

242. *McDorman & Gold, Intervention at Sea, in Int’l Mar. Org.*, *supra* note 19, at 280-82 (recounting the grounding of the *Torrey Canyon*). After grounding in English territorial waters, the *Torrey Canyon* spilled over 50,000 tons of oil. *Id.* The wreck caused significant economic damage to the coastal interests of England and France. *Id.* England eventually bombed the ship to abate the pollution threat.

243. See Abecassis, *supra* note 221, at 301 (stating that the *Torrey Canyon* incident highlighted the absence of an International Convention dealing with liability for oil pollution from ships and that the IMO provided nations with an appropriate forum to address the issue).

244. See *The International Convention Relating to Intervention on the High Seas*
an international oil pollution compensation fund.\(^2\)

2. **MARPOL 73/78**

MARPOL seeks to eliminate intentional polluting of the marine environment with oil and other harmful substances and to minimize the accidental discharge of such substances.\(^2\) MARPOL built upon the framework established in the International Convention for the Prevention of Pollution of the Seas by Oil, 1954 (OILPOL).\(^2\) OILPOL established "prohibited zones" and limited the discharge of oil mixtures to at least 50 miles from the nearest land.\(^2\) MARPOL, however, deals not only with the discharge of oil and oil mixtures, but also with a broad range of ship-generated marine pollution.\(^2\)

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\(^{247}\) Id. In March, 1962, a conference convened by the IMCO reviewed and amended the 1954 OILPOL Convention to prohibit discharges of oil and/or oily substances from vessels into restricted areas or within 50 miles of land. Id. The amendments also required oil record books for cleaning and discharges of oil. \textit{Id.} On September 1, 1966, Congressional approval of amendments to the Oil Pollution Act of 1961 brought the amendments into force in the United States on May 18, 1967. \textit{Id.} Subsequent amendments in the form of an IMCO Resolution dated October 21, 1969, accepted internationally on October 14, 1971, abandoned the prohibited zone limitations, and generally prohibited any discharges within 50 miles of land. \textit{Id.} Under these amendments, tankers may discharge operational wastes while en route only if the rate of discharge does not exceed 60 liters per mile and the total oil discharged on a ballast voyage does not exceed one part per 15,000 of total cargo capacity. \textit{Id.} MARPOL incorporated these discharge rates with slightly more stringent standards for new vessels. MARPOL Convention, supra note 19, reg. 9(1)(a). \textit{See infra} note 268 (comparing MARPOL and OILPOL).

\(^{248}\) MARPOL Convention, supra note 19, art. 2, para. 2. MARPOL defines harmful substance as "\textit{[a]ny substance which, if introduced into the sea is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.}" \textit{Id.} The Convention provides three exceptions to the regulation of discharges. \textit{Id.} at para. 3. The term "dis-
MARPOL contains five annexes, the first two of which are binding on states party to the agreement. Annex I concerns oil pollution prevention, regulating primarily oil tankers of 150 gross tons and above and/or ships of 400 gross tons or more.\(^{291}\) Annex I also sets standards for ship construction, oil, and oil mix discharge limits, and completely prohibits the discharges of oil substances in "special areas."\(^{292}\) Annex II sets detailed discharge requirements for all ships carrying chemicals in bulk.\(^{293}\) Like Annex I, Annex II designates special areas with more stringent requirements and requires maintenance of cargo record books tracking shipments on a tank-to-tank basis.\(^{294}\) In addition, both Annex I and II require contracting states to maintain adequate reception facilities at ports that receive the regulated substances.\(^{295}\)

Annexes III, IV, and V are "optional annexes" that a contracting state to the agreement may decline to accept.\(^{296}\) Annex III regulates the shipping of harmful substances in packaged forms; freight containers, portable tanks, and road and rail tank wagons.\(^{297}\) This Annex establishes packaging and label requirements, stowage regulations, and quantity limitations designed to minimize potential threats to the marine environment.\(^{298}\) Annex IV establishes discharge limitations that regulate at sea discharges of sewage pollution from ships.\(^{299}\) Annex V regulates the disposal of garbage from ships. It is the only Annex that has entered into force.\(^{300}\) It is within this context that Annex V of charge" does not include: (1) the dumping of land-generated wastes regulated under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention); (2) the release of harmful substances arising from the exploration and exploitation of sea-bed mineral resources; or (3) the release of harmful substances pursuant to legitimate scientific research into pollution abatement or control. Id.

251. MARPOL Convention, supra note 19, Annex I, reg. 4, para. 1, reg. 5, para. 1.  
252. Id. reg. 10, para. 1. The special areas under Annex I are the Mediterranean Sea, the Baltic Sea, the Black Sea, the Red Sea, and other specific Gulf areas. Id.  
254. Id. reg. 9.  
255. Id. Annex I, reg. 12, para. 1; Annex II, reg. 7, para. 1.  
256. Id. art. 14, para. 1.  
257. Id. Annex III, reg. 1, para. 1. As of February 1989, 48.23% of the world's gross shipping tonnage have ratified Annex III. Coast Guard Commandant Instruction, supra note 20, enclosure 4.  
258. Id. regs. 1-8.  
259. Id. Annex IV, reg. 10, para. 1. Annex IV establishes standards for sewage treatment, limits the discharge of treated sewage to beyond 12 nautical miles, and requires those states party to the Convention to provide adequate sewage reception facilities at all ports. Id. regs. 8-10. As of February, 1989, 40.61% of the world's gross shipping tonnage have ratified Annex IV. Coast Guard Commandant Instruction, supra note 20, enclosure 4.  
260. See infra notes 261-64 and accompanying text (discussing United States rati-
MARPOL is addressed in the following section.

III. IMPLEMENTATION OF OPTIONAL ANNEX V OF MARPOL

Optional Annex V entered into force world-wide on December 31, 1988, following United States Senate ratification a year earlier. The Annex, drafted in 1973, prohibits ships from disposing of any plastics at sea and severely restricts the discharge of certain other ship-generated wastes. United States implementing legislation and regulations apply to all domestic ports, foreign ships within the 200 mile Exclusive Economic Zone, and to vessels of United States registry anywhere in the world.

A. ANNEX V OF MARPOL

Annex V expressly prohibits all ships from discharging any plastics into marine waters, including such debris as synthetic ropes, synthetic fishing nets, and plastic garbage. Unlike Annexes I and II that apply...
to certain types of vessels, regulations under Annex V apply to all ships from the largest supertanker to the smallest recreational craft.\textsuperscript{266} Floating platforms and oil rigs are also regulated.\textsuperscript{267} Similar to the prohibitions on oil discharges in OILPOL of 1954 and Annexes I and II of MARPOL, Annex V establishes strict requirements for the disposal of other ship-generated wastes within certain distances from land.\textsuperscript{268} Disposal for dunnage and packing materials that float is banned within twenty-five nautical miles of the nearest land.\textsuperscript{269} Similarly, ships are not permitted to deposit food wastes or any other garbage, including paper products, rags, metal, glass, bottles, or crockery into marine waters within twelve nautical miles of land.\textsuperscript{270} Annex V permits disposal of this latter category of food and other wastes into waters beyond three nautical miles when commuted or ground to allow passage through a screen with openings not greater than twenty-five millime-


\textsuperscript{266} MARPOL Convention, supra note 19, Annex V, reg. 2.

\textsuperscript{267} Id. reg. 4. Fixed or floating oil drilling rigs and support vessels within 500 meters of such facilities are not allowed to dispose of any materials. Annex V does, however, provide exception for rigs more than 12 nautical miles from shore which can dispose of commuted food wastes capable of passing through a screen with openings of 25 millimeters. Id.

\textsuperscript{268} Compare MARPOL Convention, supra note 19, Annex V, reg. 3(1)(b) (prohibiting discharges of lining and packing materials that float within 25 nautical miles, and food wastes within 12 nautical miles) with OILPOL, supra note 248 (prohibiting oil discharges in particular zones and generally within fifty miles of land). For parties to MARPOL, MARPOL 73/78 supercedes OILPOL and its subsequent amendments. OFFICE OF THE SPECIAL REPRESENTATIVE OF THE SECRETARY-GENERAL FOR THE LAW OF THE SEA, THE LAW OF THE SEA 33 (1985). In addition to banning all plastics disposal and providing limits on waste disposal near land, Annex V requires that all garbage be disposed of as far as possible from the nearest land. MARPOL Convention, supra note 19, Annex V, reg. 3. See supra note 249 (discussing oil discharge limitations in OILPOL).

\textsuperscript{269} MARPOL Convention, supra note 19, Annex V, reg. 2(1)(b)(ii).

\textsuperscript{270} MARPOL Convention, supra note 19, Annex V, reg. 2(1)(b)(ii).
Mixed garbage warrants the more stringent criteria. Annex V provides three general exceptions to the garbage disposal requirements. First, the requirements do not apply in instances where disposal of garbage from a ship is necessary to secure the safety of a ship and its passengers or to save a life at sea. Second, the discharge of garbage resulting from damage to a ship or its equipment is exempted, provided that all reasonable precautions were taken prior to and after the occurrence to minimize the release. Third, the regulations do not apply to the accidental loss of synthetic fishing nets or synthetic material incidental to the repair of such nets, provided that all reasonable precautions were taken to prevent such loss.

MARPOL confers port state and flag state jurisdiction. Port state jurisdiction authorizes a state to initiate proceedings under its own laws against ships voluntarily in the state's ports for violations of MARPOL occurring in the state's jurisdiction. The port state may inspect foreign vessels in its ports to determine whether a violation of MARPOL has occurred. Flag state jurisdiction authorizes a state to refer violations of MARPOL by foreign vessels in a state's jurisdiction to the state in which the violating ship is registered for appropriate enforcement action.

MARPOL does not elaborate on what actions are "reasonable" although the MEPC/25 Draft Guidelines outlines procedures for reducing the amount of potential garbage and handling and storage of garbage against which the handling of wastes might be measured. MEPC/25 Draft Guidelines, supra note 265, para. 3.4.

271. Id. reg. 3(1)(c).
272. Id. reg. 2(2).
273. Id. reg. 6(a)(c).
274. Id. reg. 6(a).
275. Id. reg. 6(b). MARPOL does not elaborate on what actions are "reasonable" although the MEPC/25 Draft Guidelines outlines procedures for reducing the amount of potential garbage and handling and storage of garbage against which the handling of wastes might be measured. MEPC/25 Draft Guidelines, supra note 265, para. 3.4.
276. MARPOL Convention, supra note 19, Annex V, reg. 6(c); see infra notes 351-54 and accompanying text (discussing proposed United States amendments to Annex V narrowing the exemption for discharges of plastics arising from the repair of fishing nets).
277. See MARPOL Convention, supra note 19, art. 4(2)(a) (stating that upon a ship's violation of the Convention within the jurisdiction of a party, that party may initiate proceedings under its own law).
278. See id. arts. 4(2)(b) (stating that upon a ship's violation of the Convention within the jurisdiction of a party, that party may furnish information and evidence of the violation to the administration of the ship); art. 4(1) (stating that upon finding sufficient evidence of a violation, the administration shall initiate proceedings against the ship in accordance with its domestic law as soon as possible).
279. See supra note 277 (citing MARPOL port state provisions).
280. MARPOL Convention, supra note 19, art. 6(2).
281. See supra note 278 (citing flag state jurisdictional provisions in MARPOL). Flag state jurisdiction is criticized because the state in which the ship is registered often determines that no violation occurred. Hearings on H.R 940, supra note 49, at 451 (testimony of Sally Ann Lentz, member of the Entanglement Network Coalition) (noting that the United States often reports violations occurring in the territorial sea, contiguous zone, and EEZ to the flag state for enforcement and that flag state gener-
ships under the flag of states that are party to the agreement, as well as
to nonparty state vessels in the jurisdictional waters of coastal states
party to the Annex.\textsuperscript{282} Violations of Annex V within the jurisdiction of
a state party to MARPOL require that the member state either initiate
proceedings under its own law or furnish information and evidence to
the government of the ship's registry for enforcement.\textsuperscript{283}

Like Annex I and II, Annex V designates "special areas" in which
discharges of any wastes are banned due to particular oceanographical,
ecological, and vessel traffic characteristics.\textsuperscript{284} Presently, the Mediterra-
nean Sea, Baltic Sea, Black Sea, Red Sea, and "Gulfs area" are des-
ignated as special areas.\textsuperscript{285} The United States is currently pursuing an
amendment to Annex V that would give special area status to the Gulf
of Mexico.\textsuperscript{286} A number of European countries and the European Com-

\textsuperscript{282} See MARPOL Convention, supra note 19, Annex V, reg. 2 (stating the provi-
sions of Annex V shall apply to all ships). Parties to MARPOL must apply the require-
ments of the Convention to nonmembers to ensure that more favorable treatment is not
given to such ships. \textit{Id.} art. 5(4).

\textsuperscript{283} MARPOL Convention, supra note 19, art. 4(2).

\textsuperscript{284} Compare MARPOL Convention, supra note 19, Annex V, reg. 1(3) (defining
special area as a region that, because of its recognized oceanographical and ecological
conditions and its vessel traffic, requires the adoption of special mandatory methods for
the prevention of sea pollution) with \textit{id.} Annex I, reg. 1(10) (relating to oil pollution)
and \textit{id.} Annex II, reg. 1(7) (relating to noxious liquid substances). All three annexes
provide virtually identical language defining special areas and simply substitute the
1(3). Annex I and V each designate as special areas the Mediterranean Sea, Baltic
5. Annex II only designates the Baltic Sea and the Black Sea as special areas. MARPOL
Convention, supra note 19, Annex II, reg. 1(7).

\textsuperscript{285} MARPOL Convention, supra note 19, Annex V, reg. 5. Disposal of all plas-
tics and other garbage is prohibited in special areas and food wastes may be disposed in
special areas as far as practicable from land, but not into waters less than 12 nautical
miles from land. \textit{Id.} reg. 2(b).

\textsuperscript{286} See 133 CONG. REC. S15,846 (daily ed. Nov. 5, 1987) (statement of Senator
Bentsen) (introducing an amendment to the Senate Resolution that urges the United
States government to make reasonable efforts to obtain a special area designation for
the Gulf of Mexico). The United States delegation to the IMO previously announced
its intention to seek approval for the designation. \textit{Id.} The U.S. Coast Guard has pre-
pared an economic impact analysis designating the Gulf of Mexico as a special area
under Annex V. EASTERN RESEARCH GROUP, ECONOMIC ANALYSIS OF DESIGNATING
THE GULF OF MEXICO AS A "SPECIAL AREA UNDER ANNEX V OF THE MARPOL
PROTOCOL B-56 (1988) (submitted to the U.S. Dept. of Transportation). The analysis
projects that compliance costs for United States vessels and offshore oil operations will
be $2,175,890 over the projected $5,652,710 in compliance costs associated with cur-
rent Annex V regulations. \textit{Id.}
munity have also requested special area designation for the heavily travelled North Sea.  

Annex V requires the government of each signing party to ensure the provision of adequate waste reception facilities at its ports and terminals for receiving garbage from vessels without undue delay. Governments are directed to notify the IMO of all cases where facilities pertaining to Annex V are allegedly inadequate. Annex V, however, does not set a deadline for nations to establish adequate waste reception facilities.  

B. United States Implementing Legislation and Interim Regulations  

288. MARPOL Convention, supra note 19, Annex V, reg. 7(1).  
289. Id. reg. 7(2).  
290. Id. at para. 2. Annex V requires simply that “[t]he Government of each party to the Convention undertakes to ensure the provisions of facilities at port and terminals for the reception of garbage, without causing undue delay to ships, and according to the needs of ships using them.” Id. The IMO is currently working on guidelines to assist ports and terminals in determining the waste disposal needs of ships. MEPC/25 Draft Guidelines, supra note 265.  
292. See 33 U.S.C. § 1901(7) (1982 & Supp. V 1987) (defining “Secretary” as the Secretary of the department in which the Coast Guard is operating); see, e.g., MPPRCA § 2102, 33 U.S.C. § 1902(c) (Supp V 1987) (requiring the Secretary to prescribe regulations applicable to ships not party to MARPOL that are no more favorable than those accorded to ships of states parties to MARPOL).  
294. See MPPRCA § 2002, 33 U.S.C. § 1901 (Supp. V 1987) (note discussing effective date of amendments to the APPS) (stating that Title II of Pub. L. No. 100-220 shall be effective on the date in which Annex V to MARPOL enters into force in the United States); see also MARPOL Convention, supra note 19 and accompanying text (discussing the effective date of MARPOL Annex V).  
295. Regulations Implementing the Pollution Prevention Requirements of Annex V
The MPPRCA applies Annex V regulations to all foreign and domestic ships, ports, and terminals in the navigable waters or the EEZ of the United States.\textsuperscript{296} It further applies Annex V waste disposal limitations to ships either of United States registry or nationality or any ship operated under the authority of the United States anywhere in the world.\textsuperscript{297} Notwithstanding the exemptions in MARPOL for warships, navy vessels, and other vessels in government service,\textsuperscript{298} the MPPRCA requires United States government vessels to comply with Annex V regulations no later than December 31, 1993.\textsuperscript{299}

The MPPRCA empowers the Coast Guard to inspect any vessel in United States territorial waters to verify whether the ship disposed of garbage in violation of Annex V or the MPPRCA.\textsuperscript{300} Both vessels of United States registry or nationality and vessels operating under the authority of the United States may be inspected at any time to verify a violation of the MPPRCA.\textsuperscript{301} Unlike the Refuse Act of 1899, the MPPRCA permits the Coast Guard to issue civil penalties of up to $25,000 for each violation of the MPPRCA and $5,000 for each misstatement or misrepresentation.\textsuperscript{302} In addition, criminal sanctions with fines up to $50,000 and/or imprisonment of up to five years may be imposed upon persons who knowingly violate MARPOL, the MP-
PRCA, or United States regulations promulgated thereunder.\textsuperscript{303}

In accordance with MARPOL, the Coast Guard, in coordination with the Secretary of State, may choose to refer alleged violations of ships under the registry of another state party to Annex V to that flag state for appropriate action.\textsuperscript{304} However, the APPS permits the Coast Guard to proceed under United States law against violators under flag states not party to MARPOL\textsuperscript{305} and in instances where referral procedures have proven ineffective.\textsuperscript{306}

The MPPRCA requires the Coast Guard to inspect and issue certificates of adequacy to certain ports or terminals in order to ensure adequate waste reception facilities.\textsuperscript{307} It empowers the Coast Guard to deny ships entry to a port or terminal that does not provide adequate waste reception facilities in accordance with regulations issued under the Act.\textsuperscript{308} Civil and criminal penalties may also be levied against persons that fail to comply with appropriate port regulations or that make false representations to the government.\textsuperscript{309}

The MPPRCA also directs the Coast Guard to promulgate regulations that require sea-going ships subject to Annexes I and II to maintain refuse record books, waste management plans, and notification

\begin{itemize}
  \item \textsuperscript{303} 33 U.S.C. § 1908(a) (1982 & Supp. V 1987). Courts are permitted to award an amount equal to no more than one-half the fine assessed to any person for providing information leading to a conviction under the APPS as amended. MPPRCA § 2105, 33 U.S.C. § 1908 (Supp. V 1987).
  \item \textsuperscript{304} 33 U.S.C. § 1908(f) (1982). MARPOL permits party states, upon a determination that sufficient evidence of a violation exists, to either cause proceedings to be taken in accordance with its own law, or furnish to a violating ship's government with the information and evidence it possesses relating to the violation. MARPOL Convention, supra note 19, art. 4(2).
  \item \textsuperscript{306} 33 U.S.C. § 1908(f) (1982); see MARPOL Convention, supra note 19, art. 4(2) (permitting a state to either bring proceedings against a violator or refer the incident to the state of the ship's registry for action).
  \item \textsuperscript{307} MPPRCA § 2103, 33 U.S.C. § 1905(c) (Supp. V 1987). Certificates of Adequacy for Reception Facilities for Garbage are required for ports or terminals that: (1) receive ocean-going tankers or vessels of 400 gross tons or more; (2) receive vessels carrying noxious liquid substances; and (3) fishing vessels that off-load more than 500,000 pounds of commercial fishery products in a calendar year. Interim Regulations Implementing Annex V, 54 Fed. Reg. 18,408 (1989) (to be codified at 33 C.F.R. § 158.135). All ports and terminals under the jurisdiction of the United States receiving foreign vessels other than from Canada must be capable of receiving APHIS-regulated garbage on 24 hours notice. Id. at 18,409 (to be codified at 33 C.F.R. § 158.410); see supra note 166 and accompanying text (discussing APHIS waste handling requirements).
  \item \textsuperscript{309} 33 U.S.C. § 1908(a)(b) (1982).
\end{itemize}
placards alerting passengers and crews of Annex V requirements.\textsuperscript{310} In addition, Congress directed the Coast Guard to seek an international agreement that would employ similar requirements to similar vessels subject to Annex V of MARPOL.\textsuperscript{311} The Coast Guard announced its intention to propose international requirements for refuse record books for certain ships under MARPOL at the meeting of the IMO’s Marine Environment Protection Committee (MEPC) in 1989.\textsuperscript{312}

\textbf{IV. LIMITS OF ANNEX V IN REDUCING MARINE PLASTICS}

The MPPRCA clearly implements the requirements of Annex V in United States jurisdictional waters.\textsuperscript{313} Annex V, however, only concerns plastics pollution from ships and mineral resource platforms at sea and will not curtail the tremendous volume of plastic debris entering marine waters from land-based sources.\textsuperscript{314} Moreover, difficult questions per-

\textsuperscript{310} MPPRCA § 2107, 33 U.S.C. § 1903(b)(2)(A)(i) (1982 and Supp. V 1987). The Coast Guard chose not to address these requirements in its interim regulations; see Interim Regulations Implementing Annex V to MARPOL 73/78, 54Fed. Reg. 18,405 (1989) (reserving sections 151.55-59 pertaining to recordkeeping requirements, waste management plans, and placards). The Coast Guard has proposed regulations that would require manned United States ocean-going ships 79 feet or more in length engaged in commerce and manned, fixed, or floating platforms to maintain a refuse record book that documents the disposal of garbage. Prevention of Pollution from Ships, 54 Fed. Reg. 37,084 (1989) (to be codified at 33 C.F.R. § 151.55 (proposed Sept. 6, 1989). Under the proposed rules, all ocean going ships 40 feet or more in length are required to maintain a waste management plan detailing waste handling practices. Id. (to be codified at 33 C.F.R. § 151.57). Information placards summarizing Annex V waste discharge requirements must be posted by persons in charge of ships 26 feet in length or more under the proposed rules. Id. (to be codified at 33 C.F.R. § 151.59).


\textsuperscript{312} See United States Coast Guard, Annex V of MARPOL 73/78, A Compendium of Implementing Materials in the United States B-67 (Jan. 11, 1989) (compiled by ps1 L. Berney) [hereinafter Compendium of Implementing Materials] (stating that the Coast Guard does not favor establishing recordkeeping requirements for United States vessels without having exhausted the possibility of consistent and mandatory international requirements for ships subject to MARPOL). The Coast Guard announced its intention to propose international recordkeeping requirements at the 27th Session of the MEPC in March of 1989. Id.

\textsuperscript{313} See Manheim, supra note 23, at 98 (confirming that amendments to the Act to Prevent Pollution from Ships made by the Marine Plastic Pollution Research and Control Act extend Annex V provisions to ships of United States registry and/or nationality, foreign ships, and United States ports and terminals).

\textsuperscript{314} See MARPOL Convention, supra note 19, Annex V, regs. 2, 4 (stating that Annex V applies to all ships and also covers fixed or floating platforms); see also supra notes 45-48 and accompanying text (discussing the land-based sources of plastics
taining to Annex V remain. For example, issues concerning enforce-
ment,\textsuperscript{315} adequate reception facilities,\textsuperscript{316} the continued loss of fishing
gear,\textsuperscript{317} and at sea incineration,\textsuperscript{318} must still be resolved. Resolution of
these difficulties will determine the long-term success of Annex V and
United States implementing legislation in protecting marine resources
from plastics pollution.

\section{Enforcement and Jurisdiction}

MARPOL Annex V uniquely regulates all ships, irrespective of
size.\textsuperscript{319} Although Annex V is far more inclusive than Annexes I and II,
MARPOL fails to impose recordkeeping requirements for the handling
of garbage comparable to those for oil and hazardous chemicals.\textsuperscript{320} Ac-
cordingly, enforcement actions against ships suspected of discharging
wastes in violation of Annex V will not include reviews of waste record
books,\textsuperscript{321} an approach included in Annexes I and II.\textsuperscript{322} Failure to in-

\textsuperscript{315}See Manheim, supra note 23, at 100-06 (discussing problems of enforcement
and jurisdiction under Annex V).

\textsuperscript{316}Id. at 105.

\textsuperscript{317}See Fjelstad, supra note 98, at 689 (stating that current deficiencies in gear
marking systems limit enforcement of Annex V against ships disposing of synthetic
fishing gear).

\textsuperscript{318}See 53 Fed. Reg. 43,625 (1988) (discussing discharge limitations MARPOL
73/78) (proposed Oct. 27, 1988) (stating that the United States Coast Guard is con-
cerned that further study is needed on the issue of incinerator ash disposal). The Coast
Guard has also requested that the guidelines concerning at sea incineration and ash
disposal be addressed by the MEPC of the IMO. Id.

\textsuperscript{319}MARPOL Convention, supra note 19, Annex V, reg. 2; see Interim Regula-
that the rules apply to marine craft of any size or type).

\textsuperscript{320}See MARPOL Convention, supra note 19, Annex I, reg. 20 (requiring oil
tankers of 150 gross tonnage or more and ships of 400 gross tonnage or more to main-
tain oil record books tracking the loading, transfer, disposal, and unloading of oil); Id.
Annex II, reg. 9 (requiring a cargo record book to be maintained for tracking chemical
cargos on a tank-to-tank basis).

\textsuperscript{321}See MARPOL Convention, supra note 19, Annex V (prohibiting the dis-
charge of plastics and regulating the discharge of other wastes, but not requiring the
maintenance of records for waste handling). In determining whether a violation of An-
nex V has occurred, the United States Coast Guard will review such factors as: (1)
records or receipts of garbage discharge at port; (2) ship log entries; (3) presence and
operability of waste treatment equipment such as incinerators, grinders, and com-
minuters; (4) adherence to written waste management plans; (5) absence of plastics in
ship stores; (6) educational programs and; (7) shipboard spaces for storing plastic
(1989) (to be codified at 33 C.F.R. § 151.63). A prima facie case for establishing a
violation of Annex V entails proof that: (1) there is an absence of plastics for disposal
on board; (2) an inspection indicates that plastics are used on the vessel; (3) there is
not an operating incinerator or other reasonable explanation of lawful disposal; and (4)
there is no evidence of proper disposal since the ship's arrival in port. Coast Guard
clude record keeping requirements in Annex V greatly increases the
difficulty of ensuring proper disposal of ship-generated wastes because
it is difficult to police the world's oceans and often impossible to link
wastes to a particular ship.

Jurisdictional restrictions on actions a state may take against vessels
outside its territorial waters also limit effective enforcement of Annex
V. Article six of the MARPOL Convention authorizes port-state jur-
sisdiction, declaring that a ship subject to the Convention in any port
or terminal of a member state is subject to inspection by that state's
authorities to determine whether the ship has disposed of any harmful
substances in violation of MARPOL regulations. Similarly, states
party to the Convention are allowed to inspect a ship within the state's
jurisdiction at the request of another state party to MARPOL, pro-
vided that the state requesting the inspection provides sufficient evi-
dence showing a discharge in violation of MARPOL.

State enforcement options under MARPOL do not specifically in-
clude at sea inspection. MARPOL states that “jurisdiction” is to be
construed under the general norms of international law in force at the
time the Convention is applied or interpreted. Accordingly, “coastal

Commandant Instruction, supra note 20 at 2-2.
322. See supra note 320 (discussing oil and cargo record books under MARPOL
Annexes I and II).
323. See Prevention of Pollution from Ships, 54 Fed. Reg. 37,084 (stating that the
Coast Guard proposes Refuse Record Books for ocean-going ships 79 feet in length or
more because these ships generate and discharge garbage “in areas where there is little
outside incentive to comply with the regulations concerning the disposal of garbage”).
The Coast Guard expects the Refuse Record Books to be a useful enforcement tool
that will also provide data on waste handling). Id. The United States Congress recog-
nized the use of log books tracking waste disposal as a useful enforcement tool that
would help to increase the awareness of vessel operators under the requirements of
324. See supra note 219 and accompanying text (stating that it is virtually impos-
ible to link debris with a particular violator).
325. Nat'l Ocean Policy Study Hearings, supra note 4, at 74 (statement of Sally
Ann Lentz, Staff Attorney for the Oceanic Society) (discussing the limited rights of
costal states to respond to violations of international and domestic environmental laws
within their respective EEZ).
326. MARPOL Convention, supra note 19, arts. 4-6. Additionally, article 14
places both flag ships of member states party to Annex V and nonparty vessels under
the jurisdiction of the Convention for purposes of the Annex. Id.
327. MARPOL Convention, supra note 19, art. 6(2).
328. See id. art. 6(5) (noting that a request for inspection must be made by a party
to the Annex and accompanied by “sufficient evidence”). Sufficient evidence is not de-

cined in the Convention. Id.
329. See MARPOL Convention, supra note 19, arts. 3-6 (discussing flag-state ju-
risdiction and state jurisdiction over vessels in ports or terminals of a member state, but
not addressing jurisdiction over ships at sea).
330. MARPOL Convention, supra note 19, art. 9(3).
state" jurisdiction, as embodied in the United Nations Law of the Sea Treaty,331 is arguably applicable to at sea enforcement under Annex V.332

Coastal state jurisdiction under the LOS Convention, nevertheless, limits the rights of coastal states in responding to violations of domestic or international law occurring within a state's EEZ.333 If there are clear grounds for suspecting a vessel has violated domestic or international laws or rules while in a coastal state's navigable waters or within its EEZ, the coastal state's response is limited to demanding information from the vessel to determine if a violation has occurred.334 A coastal state under the LOS may physically inspect a ship within its territorial sea or EEZ waters only if the vessel refuses to supply requested information, provides information manifestly at variance with the evident factual situation, or if the violation has resulted in a "substantial discharge" that causes or threatens significant pollution.335 Beyond this inspection hurdle, coastal state jurisdiction permits a state to detain and prosecute a vessel only if the discharge causes or threatens major damage to a state's coastline or marine resources.336 Disposal of plastics and ship-generated wastes are unlikely to meet this high standard set out under the LOS Convention. Accordingly, a state detaining and prosecuting a vessel under Annex V in its own EEZ may be in violation of customary international law.337 Thus, the effective enforcement of Annex V against ships that continue at sea disposal of wastes on the high seas and within exclusive economic zones of other states is uncertain.338

331. LOS Convention, supra note 129, pt. XII, sec. 6, art. 220.
332. See Manheim, supra note 23, at 103 (stating that, although coastal state jurisdiction is limited, "coastal state jurisdiction derived from the LOS treaty may be invoked under MARPOL Annex V"). The United States Congress has adopted port-state, flag-state and coastal-state jurisdiction under the MPPRCA. Id.
333. See Nat'l Ocean Policy Study Hearings, supra note 4, at 74 (statement of Sally Ann Lentz, Staff Attorney for the Oceamic Society) (discussing the limited rights of coastal states within their respective EEZ).
334. LOS Convention, supra note 129, pt. XII, sec. 6, art. 220, para. 3.
335. Id. art. 220, paras. 5-6.
336. Id. para. 6.
337. But see Coast Guard Commandant Instruction, supra note 20, at 2-1 (stating that the Coast Guard does not expect to conduct additional boardings exclusively for Annex V enforcement but instead will conduct inspections when Coast Guard boarding officers encounter vessels during other routine activities such as fisheries patrols, pollution investigations, marine casualty investigations, or other law enforcement activities).
338. See LOS Convention, supra note 129, pt. XII, sec. 6, art. 220, para. 3 (stating that for ships suspected of violating international standards for pollution prevention in a state's EEZ, states are limited to obtaining information for at sea enforcement). States party to MARPOL may not, however, readily detain and prosecute violators operating outside the member state's port or territorial waters. Id. at para. 6 (stating
B. THE QUESTION OF ADEQUATE FACILITIES

Annex V requires that states party to the agreement provide adequate facilities at ports and terminals for receiving garbage from ships without undue delay. As with those facilities required under Annexes I and II, the United States has chosen to allow ports and terminals to individually fulfill the facilities requirement. It is important to note that while Annex V is currently in force and governs a vast number of diverse ports, it does not mandate the provision of adequate facilities by a certain date.

At the present time, ports may not have adequate facilities due to the absence of regulations or the costs of improvements. As nations incorporate the requirements of Annex V into domestic law, it is likely that ports will at best sporadically comply with the requirements. Many nations will undoubtedly provide ports with generous opportunities to comply.

that under the LOS Convention, a state may institute proceedings and detain a vessel in the EEZ only if a discharge causes or threatens "major damage" to a state's coastline or related interests). Since a state could request information on registration, destination and the like, it is arguable that proceedings against the vessel could be undertaken the next time the vessel is in the state's ports. It is clear that a state to MARPOL could forward "sufficient evidence" to a subsequent state party to MARPOL for enforcement. MARPOL Convention, supra note 19, art. 6(5). States, however, are reluctant to prosecute vessels for violations occurring in foreign or international waters. Supra note 281.

339. MARPOL Convention, supra note 19, Annex V, reg. 7(1). States are also required to notify the IMO of all cases where facilities are alleged to be inadequate for purposes of alerting other states party to the Annex. Id. reg. 7(2).

340. See Interim Regulations Implementing Annex V of MARPOL 73/78, 54 Fed. Reg. 18,409 (1989) (to be codified at 33 C.F.R. § 158.410) (stating that a person in charge of a port or terminal is responsible for ensuring adequate facilities, which may include the handling of APHIS regulated waste and medical waste).

341. See supra notes 288-90 and accompanying text (discussing state obligations for ensuring adequate waste reception facilities).

342. See Report of the Working Group on Law and Policy (draft Aug. 1989) from the Second International Conference on Marine Debris, held at Honolulu, Hawaii, Apr. 2-7, 1989 (copy on file at the offices of the American University Journal of International Law & Policy) (noting that many signatories are lagging in implementation efforts and that most ports do not yet have adequate waste facilities for receiving plastics and other garbage). Annual costs for waste facilities imposed on the 243 principle ports in the United States alone is estimated to be 375,000 dollars for the nation's largest 25 ports and 1.82 million dollars for the 243 remaining ports. REGULATORY EVALUATION OF ANNEX V, supra note 6, at 6-58.

343. See, e.g., Memorandum from J.D. Sipes, Chief, Office of Marine Safety, Security and Environmental Protection (Jan. 13, 1989), reprinted in COMPENDIUM OF IMPLEMENTING MATERIALS, supra note 312, at C-10, 11 [hereinafter Sipes Memorandum] (stating that there are no specific requirements in the MPPRCA which require adequate facilities at ports and that enforcement of Coast Guard regulations of ports and facilities for purposes of MARPOL will not commence until June 1989).
ties to upgrade facilities, while some ports may be closed to ships for failure to provide waste reception facilities.\textsuperscript{344} Ships that are turned away from a port or that visit a port without adequate facilities will be forced to journey elsewhere to properly dispose of their wastes, including plastics.\textsuperscript{348} These inadequacies provide an incentive for ships to illegally discharge wastes and also unduly burden those ships attempting to comply with Annex V. In addition, short term inadequacies make on-board incineration an attractive and predictable solution to the waste disposal requirements for many of the world's merchant ships.\textsuperscript{349} Shipboard incineration poses its own significant threats to the marine environment.\textsuperscript{347} The absence of enforceable international standards for waste reception facilities also increases the likelihood that facilities will not be properly maintained, thereby perpetuating these short-term problems associated with inadequate waste facilities.

C. THE CONTINUED PROBLEMS OF GHOST NETS

The threat to living marine resources from lost or discarded synthetic fishing nets and equipment will continue unless additional measures are taken to limit fishing equipment losses and lessen the impact of such abandoned equipment on the oceans.\textsuperscript{348} The United States submitted amendments to the IMO that seek to strengthen Annex V regulations over fishing gear, but greater changes are needed to effectively prevent the loss of synthetic gear.\textsuperscript{349} Annex V clearly prohibits intentional disposal, but it is practically silent on the standards imposed on commercial fisheries to avoid accidental loss.\textsuperscript{350}

345. See, e.g., Sipes Memorandum, supra note 343, at C-10 (indicating that individual ships must make arrangements for disposal of their garbage until port regulations are promulgated).
346. See infra notes 382-87 and accompanying text (noting that to avoid costly port delays ships may choose on-board incineration).
347. See infra notes 367-78 (discussing the hazards of plastic incineration).
348. See Fjelstad, supra note 97, at 699 (stating that while a legal framework is in place, absent measures to reduce the amount of netting introduced into the marine environment and working incentives to cleanup existing debris, lost or discarded nets will continue to kill large numbers of marine animals annually). Nations of the South Pacific Forum are presently seeking a total ban on drift net fishing in South Pacific waters. Move to Outlaw Drift-Netting, 20 MAR. POLLUT. BULL. 422-23 (1989). The move toward a ban is primarily in response to incidental catch problems. Id.
350. See MARPOL Convention, supra note 19, Annex V, reg. 6(c) (stating that
The United States raised concerns over the adequacy of Annex V regulations for accidental loss of fishing gear prior to adopting the Annex. The United States indicated that the exemptions found in regulation six of Annex V, addressing the loss of synthetic materials incidental to the repair of synthetic nets, permitted disposal of materials and netting used to repair and maintain the nets. The Marine Environment Protection Committee (MEPC), at its 23rd session, agreed to a requested amendment proposed by the United States that deletes the words "or synthetic material incidental to the repair of such nets" from the regulations of Annex V. The amendment will become effective unless, according to MARPOL procedures, one-third of the parties to Annex V or members representing fifty percent of the world's gross shipping tonnage formally object. The amendment narrows the exemptions for disposal related to repairs of synthetic gear, but does little to strengthen the enforceability of provisions banning the negligent loss or intentional disposal of fishing gear.

Losses of synthetic gear are exempted from Annex V provided that "reasonable precautions" are taken to prevent such loss. Unlike Annex I and II that provide detailed standards for the proper construction of oil and chemical cargo vessels, however, neither Annex V nor the Draft MEPC guidelines establish any standards relating to fishing gear construction, handling, or performance against which a loss may be measured. Consequently, enforcement of the regulation beyond witnessed disposal or linkage of a particular net to a vessel is unlikely. Congress, however, enacted the Driftnet Impact Monitoring, Assessment, and Control Act of 1987, concurrently with Annex V implementing legislation, which requires that the Coast Guard pursue international agreements that would monitor drift net losses and impacts.
Absent further agreements that establish international standards for gear marking, care, and equipment requirements, Annex V will have a limited impact on driftnet losses. 360

D. THE INCENTIVES AND HAZARDS OF AT SEA INCINERATION

The potential difficulties encountered at port facilities 361 and escalating costs associated with solid waste disposal on land 362 create incentives for ships to choose on-board incineration to satisfy their garbage disposal needs under Annex V. 363 Both the MARPOL Convention and United States regulations clearly intend onboard incineration to be an option under Annex V. 364 The practice of at sea incineration of ship wastes is largely unregulated under either international or United States domestic law. 365 Moreover, ship-board incineration and ash dis-

360. Fjelstad, supra note 98, at 699.
361. See infra note 383 and accompanying text (noting that the cost of labor for handling ship wastes is often uncertain).
362. See infra note 382 and accompanying text (discussing the growing limitations and costs associated with landfills).
363. See Notice of Proposed Rulemaking Regarding Automatic Auxiliary Boilers, 54 Fed. Reg. 47,229 (proposed Nov. 13, 1989) (stating that "the Coast Guard is expecting a large influx of incinerator approval requests" resulting from the adoption of MARPOL Annex V).
364. See MEPC/25 Draft Guidelines, supra note 265, pt. 1.5.15 (defining incinerator ash as all other garbage under Annex V); Interim Regulations Implementing Annex V of MARPOL 73/78, 54 Fed. Reg. 18,406 (1989) (to be codified at 33 C.F.R. §151.67) (stating that "all garbage containing plastics . . . must be discharged ashore or incinerated").
365. See Hearings on H.R. 940, supra note 49, at 457 (testimony of Sally Anne Lentz, Staff Attorney for the Oceanic Society) (stating that emissions from ocean-based solid waste incinerators are presently unregulated); see also MEPC/25 Draft Guidelines, supra note 265, pt. 5.4 (noting that marine incinerator technology is at a "primitive level" primarily because the constraints on hazardous air emissions and requirements for hazardous wastes have not been applied to marine incineration). Some harbors of the world have requirements for the control of air pollution. Id. Ships can meet these requirements by not using incinerators in those harbors and instead using the burners while in other marine waters. Id.

At sea ash disposal of incinerated incidental ship wastes is currently unregulated in the United States, beyond the discharge requirements of Annex V. Incinerator residue is specifically listed as a regulated material under the MPRSA. 40 C.F.R. § 220.2(d) (1988). As discussed earlier, however, incidental ship wastes not brought to sea for dumping are exempt from the MPRSA. Supra note 183. Therefore, ash disposal from on board incineration of incidental ship wastes is not within the scope of prohibited acts under the MPPRCA or the MPRSA. Supra notes 178-83 (discussing United States dumping laws). The Clean Water Act also prohibits the discharge of incinerator ash. 33 U.S.C. § 1362(6) (1982) (including "incinerator residue" in the definition of pollutant). The Clean Water Act prohibits discharges of wastes into territorial waters but is not enforced. Supra note 197. Although incinerator ash is a regulated pollutant, discharges from ships operating in the contiguous zone or EEZ are exempted from the Act. 33 U.S.C. § 1362(12)(B) (1982).
posal may have devastating effects on the marine environment.\textsuperscript{366}

Plastics require high incineration temperatures and incineration technology has not perfected the complete destruction of such materials.\textsuperscript{367} Toxins such as dioxins can be generated if plastics are burned at inadequate temperatures.\textsuperscript{368} The incineration of solid waste releases air emissions that may contain a variety of acidic gases, particulate lead, cadmium, and other toxic metals, as well as hazardous organic compounds such as dioxins.\textsuperscript{369} These emissions from land-based solid waste incinerators are a suspected health threat to humans and the environment.\textsuperscript{370} The bottom and fly ash that result from incineration is also hazardous. The ash, similar to the emissions, may contain toxic levels of cadmium and lead, as well as dioxins.\textsuperscript{371}

Dioxins are extremely toxic and persistent compounds that bioaccumulate\textsuperscript{372} in the environment.\textsuperscript{373} Similarly, disposing of toxic metals

Senator Wilson introduced legislation in the 101st Congress that would amend the Clean Air Act by extending the Act's provisions to cover air pollution on and over the Outer Continental Shelf. S. 782 101st § 327 Cong., 1st Sess. (1989). The Oslo Convention will ban at sea incineration of wastes as of December 31, 1994. \textit{Oslo and Paris Commissions Meet}, 19 MAR. POLLUT. BULL 498 (1988). It is unclear whether this ban will include the incineration of wastes incidental to the operation of ships. A similar phaseout of marine incineration is to take effect under the London Dumping Convention. \textit{Ban on Marine Incineration}, 19 MAR. POLLUT. BULL 648 (1988). As the London Dumping Convention specifically exempts wastes incidental to the operation of ships, it is likely that the prohibition on incineration will not extend to such wastes. See supra notes 125-28 (discussing incidental wastes under the London Dumping Convention).

366. \textit{See infra} notes 367-78 (discussing the hazards of at sea incineration and ash disposal).


368. \textit{Id.; see supra} note 365 (noting that the MEPC guidelines consider shipboard incineration technology to be at a "primitive level").

369. \textit{See To Burn or Not to Burn, supra} note 39, at 78 (noting that even with modern pollution control, emissions levels may remain harmful to human health); \textit{see also} Laversuch, \textit{Incineration, Modern Plastics}, May 1989, at 34-35 (noting public concern over by-products of plastic incineration). These by-products may include dioxins and furans, heavy metals such as lead and cadmium, and various acidic gases. \textit{Id.}


371. \textit{See United States Environmental Protection Agency, Characterization of MWC Ashes and Leachates from MSW Landfills, Monofills, and Co-disposal Sites ES-3-4} (1987) (noting that researchers have often found toxic levels of cadmium, lead, and traces of other heavy metals in solid waste incinerator ash). In 1989, Congress considered amendments to RCRA that would regulate ash from municipal garbage incinerators. \textit{Broad Support for Ash Bill Voiced}, 20 Env't Rep. (BNA) 140 (May 19, 1989) (discussing H.R. 2162 that would treat ash as a "special waste" and noting that incinerator ash contains toxic levels of metals).

372. \textit{See Wastes in Marine Environments, supra} note 119, at 92 (defining bioaccumulation as the process whereby a substance enters an organism through the
such as cadmium\textsuperscript{374} and lead\textsuperscript{376} in the marine environment is, as one commentator observed, paramount to placing them "at the gates of the food chain where they can poison not only significant quantities of marine life, but also the human population at the top of the food chain."\textsuperscript{376} Although the United States Coast Guard has adopted interim regulations permitting ash disposal at sea,\textsuperscript{377} the Environmental Protection Agency (EPA) strongly opposes at sea disposal of incineration water or through ingestion and is stored in the tissue of the organism).

373. See E. Meyer, Chemistry of Hazardous Materials 396-97 (2d ed. 1989) (noting that 2,3,7,8-tetrachlorodibenzop-dioxin, often called dioxin or TCDD, is one of the most toxic of all substances, is extremely stable, and bioaccumulates in the environment); see also Syracuse Research Corporation, Toxicological Profile for 2,3,7,8-Tetrachlorodibenzop-Dioxin 1, 72-74 (Report prepared for the United States Health Service Agency for Toxic Substances and Disease Registry) (June, 1989) (noting that incineration of municipal wastes is a source of dioxins and that photodegradation in water is slow); Dioxin: A Highly Toxic, Persistent Contaminant in Environmental Defense Fund/ Environmental Information Exchange, Fact Sheet (available from the Environmental Defense Fund) (stating that dioxins are among the most toxic substances known, and that the compounds tend to "bioconcentrate" in the food chain due to their resistance to chemical or biological breakdown). Research suggests that dioxins form as a result of incomplete combustion of municipal wastes. Laversuch, supra note 369, at 34-35. Scientists have also linked dioxin to birth defects, cancer, and immune system failure. Id. Increased amounts of dioxin in marine environments continue to concern researchers around the globe. Dioxin Problems in the Aquatic Environment, 19 Mar. Pollut. Bull. 347 (1988) (discussing a symposium addressing dioxins held at the University of Nevada, Las Vegas, October 4-9, 1987, attended by representatives from seventeen nations).

374. See Life Systems, Inc., Toxicological Profile for Cadmium 59 (Report prepared for the United States Public Health Service Agency for Toxic Substances and Disease Registry) (March 1989) (noting that the largest source of cadmium release into the environment is the burning of petroleum products and incineration of municipal wastes). Cadmium bioaccumulates in marine organisms hundreds or thousands of times higher than concentrations in the water. Id. at 61. Bioconcentration is greatest in invertebrates such as mollusks and crustaceans, followed by fish and plants. Id. See generally GESAMP: Cadmium, Lead and Tin in the Marine Environment, GESAMP (IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution); UNEP Regional Seas Reports and Studies No. 56, 6-23 (1985) [hereinafter Cadmium, Lead and Tin in the Marine Environment] (discussing the effects of cadmium on marine biota and human health).

375. See Cadmium, Lead and Tin in Marine Environments, supra note 374, 40-43 (discussing the effects of lead on marine biota and human health). Lead bioaccumulates in organisms through the pathways of ambient water, sediments, and ingestion. Id. at 34. Exposure to lead can cause significant harm to central and peripheral nervous systems in humans. Id. at 36. Marine organisms, particularly mollusks and birds, can accumulate lead from the environment. Id. at 53.

376. J. Kindt, supra note 119, at 800. The problem of mercury in tuna is one example of bioaccumulation of toxic metals. Id.

377. Interim Regulations Implementing Annex V of MARPOL 73/78, 54 Fed. Reg. 18,406 (1989) (to be codified at 33 C.F.R. § 151.69(a)(2)); The term "garbage" includes "operational wastes," which by definition includes ash and clinkers from shipboard incineration. Id. at 18,403 (to be codified at 33 C.F.R. § 151.05); see MARPOL Convention, supra note 19, Annex V, reg. 3(1)(b)-(c) (discussing permitted discharges for commuted wastes).
tor ash under Annex V.\textsuperscript{378}

In complying with Annex V, ships generally have five options for waste disposal: first, waste separation, with storage of plastic waste onboard the ship for disposal in port; second, storage of all garbage for disposal in port; third, waste separation, with compaction and storage of plastics for port disposal; fourth, incineration; and fifth, product substitution.\textsuperscript{379} The Marine Environment Protection Committee of the IMO promulgated Draft Guidelines for Annex V that expressly includes "ash and clinkers" in the term "all other garbage."\textsuperscript{380} Ships may discard ash into the sea beyond twelve nautical miles from the nearest, land or beyond three miles if the ash is capable of passing through a screen with openings no greater than twenty-five millimeters.\textsuperscript{381}

As the fees for discharging plastics and other garbage at ports rise, the competitive cost of shipboard incineration makes it a viable economic alternative.\textsuperscript{382} Shipping companies note that the availability and cost of labor to unload wastes in ports is often uncertain.\textsuperscript{383} The uncertainty of whether ports will have adequate facilities and labor, coupled with the costs of onshore waste disposal provide strong incentives for shipboard incinerators as a predictable means of waste disposal.\textsuperscript{384} Furthermore, foreign ships visiting the United States are required to comply with Animal and Plant Health Inspection Service (APHIS) regulations for the proper handling of foreign wastes that come in contact with food.\textsuperscript{385} These costs can also be avoided through onboard incineration.

\begin{itemize}
\item \textsuperscript{378} See Letter from Richard E. Sanderson, Office of Federal Activities, United States Environmental Protection Agency to Commandant, United States Coast Guard (Nov. 29, 1988) [hereinafter EPA Comments] (on file at the office of the American University Journal of International Law and Policy) (discussing ash disposal under interim Coast Guard regulations and recommending that the Coast Guard not endorse or encourage at sea ash disposal under Annex V regulations).
\item \textsuperscript{379} REGULATORY EVALUATION OF ANNEX V, supra note 6, at 6-8.
\item \textsuperscript{380} MEPC/25 Draft Guidelines, supra note 265, at para. 1.5.15.
\item \textsuperscript{381} See supra note 377 (discussing permitted discharges of incinerator ash).
\item \textsuperscript{382} See REGULATORY EVALUATION OF ANNEX V, supra note 6, at 6-24 (stating that disposal costs are rapidly increasing due to diminished landfill capacity in the United States). The EPA estimates that one third of the existing landfills in the United States will be full by 1991. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SOLID WASTE, THE SOLID WASTE DILEMMA: AN AGENDA FOR ACTION 14 (1989).
\item \textsuperscript{383} REGULATORY EVALUATION OF ANNEX V, supra note 6, at 6-45. Vessels that incinerate incidental garbage can avoid waste-associated scheduling problems and onshore waste handling regulations. Id.
\item \textsuperscript{384} Id.; see supra notes 339-47 and accompanying text (discussing the likelihood of inadequate facilities in the absence of enforceable international requirements).
\item \textsuperscript{385} See supra note 166 and accompanying text (discussing APHIS requirements for foreign ships off-loading garbage). Under the Coast Guard's interim rules, ports receiving foreign ships other than from Canada must be capable of receiving APHIS-regulated garbage on 24-hour notice. Interim Regulations Implementing Annex V of MARPOL, 54 Fed. Reg. 18, 409(1989) (to be codified at 33 C.F.R. § 158.410(A)(1).
tion and subsequent ash disposal at sea. Finally, because the ash brought to port in the United States will be subject to RCRA disposal requirements, ships will probably dump most incinerator ash at sea in order to avoid disposal and compliance costs.\textsuperscript{388} Increased international awareness of the hazards of incinerator ash may lead to similar waste handling requirements, costs and incentives in the ports of other nations.\textsuperscript{387}

The regulation became effective on August 28, 1989. \textit{Id.} 386. See EPA Comments, \textit{supra} note 378 (stating that APHIS will require ports to meet RCRA requirements in handling ship wastes); see also Interim Regulations Implementing Annex V of MARPOL 73/78, 54 Fed. Reg. 18,402 (1989) (stating that RCRA may restrict shore disposal of ash and clinkers from onboard incinerators). Regulations promulgated under RCRA exempt “household waste” and ash residue from the incineration of such refuse resulting from municipal incinerators. 40 C.F.R. § 261.4(b) (1988); 45 Fed. Reg. 33,098-99 (1980) (explaining EPA’s decision to exclude “waste streams generated by consumers at the household level” from RCRA hazardous waste regulations). Residues such as incinerator ash from incineration of household waste are also excluded under these provisions. \textit{Id.} The legislative history notes that “[RCRA] is not to be used to control the disposal of hazardous substances used in households or to extend control over general municipal wastes based on the presence of such substances.” S. REP. No. 94-988, 94th Cong., 2nd Sess. 16 (1976).

Since the incinerator ash from the incineration of wastes at sea would likely arise from commercial shipping, it may not constitute a solid waste arising from the household waste stream. \textit{Id.} The term “household waste” is defined as “any material” derived from households. 40 C.F.R. § 261.4(b)(1) (1988). The exclusion extends to multiple residences, hotels, motels, bunk houses, ranger stations and crew quarters. \textit{Id.} Although resource recovery facilities incinerating household wastes are exempt from RCRA regulations, ships at sea incinerating and disposing the ash residue of solid wastes not arising from the household waste stream appear to be subject to existing RCRA regulations. \textit{Id.}

Additionally, any ship that imports hazardous waste into the United States must comply with “manifest” documentation and control requirements under RCRA. 40 C.F.R. § 262.60 (1988). Manifest regulations require documentation of the planned vehicles and facilities handling the hazardous waste as well as information on the generation of the waste. 40 C.F.R. § 262.20(a) (1988). If incinerator ash is found to be a hazardous waste under RCRA, these regulations can be interpreted to require compliance with importation requirements as part of on shore or at sea disposal of incinerator ash. \textit{Id.}

387. See EPA Comments, \textit{supra} note 378 (stating that several incidents involving attempts to export ash for disposal in foreign nations have renewed international interest in the discharge of ash at sea). In one such incident, the \textit{Khian Sea}, a ship carrying 14,000 tons of incinerator ash from Philadelphia, searched for 27 months for a port where it could dispose of its cargo; see also \textit{Econotes}, 14 \textit{GREENPEACE} 4 (Mar./Apr. 1989) (detailing the journey of the \textit{Khian Sea}). The ship dumped 4,000 tons of ash in Haiti by listing the cargo as fertilizer on applicable permits. \textit{Id.} It then changed its name while at port in Yugoslavia, and after being denied entry to a number of foreign ports, it dumped its load at sea. \textit{Id.} The recent adoption of the Basel Convention also lends support to the view that nations around the world will further regulate hazardous wastes. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, \textit{adopted and opened for signature} March 22, 1989, \textit{reprinted in} United Nations Environmental Programme, \textit{Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal: Final Act} [hereinafter \textit{BASEL CONVENTION}], \textit{also reprinted in} 28 I.L.M.
Currently, neither international law nor the Clean Air Act regulates emissions from at sea incinerators.\textsuperscript{388} Coast Guard regulations pertaining to onboard incineration concern only design, construction, and repair standards for incinerators and do not regulate air emissions or ash disposal.\textsuperscript{389} Neither Congress nor the EPA has established standards for air emissions from ocean-based incinerators or for disposal of bottom ash from land or sea-based incinerators.\textsuperscript{390} The Coast Guard, however, has requested the MEPC of the IMO to consider the issue of ocean ash disposal, expressing concerns that the organization has not given the issue adequate attention.\textsuperscript{391}

V. RECOMMENDATIONS TO ENHANCE THE EFFECTIVENESS OF ANNEX V

Annex V is the first global regime addressing at sea disposal of ship generated plastic wastes. Amendments to Annex V and separate multinational regional agreements will be necessary, however, to effectively protect the world's marine environment from plastics pollution from ships. Fortunately, MARPOL includes procedures that facilitate the adoption of amendments.\textsuperscript{392} Additionally, United States federal, state,
and local governments can take initiatives that will significantly reduce at sea disposal of plastic wastes.

A. **EXPAND THE JURISDICTION OF ANNEX V**

The nations party to Annex V should seek to expand the jurisdictional reach of the Annex by encouraging those nations already party to MARPOL to ratify Annex V. These same nations should also collectively encourage countries allowing “flags of convenience”\(^{393}\) to become parties to the MARPOL Convention. In addition, the international community should ratify the LOS Convention in order to expand the jurisdictional reach of marine pollution conventions and to take advantage of LOS provisions that grant port-state jurisdiction for violations of internationally accepted pollution standards on the high seas.

Although fifty-five nations constituting more than eighty percent of the world’s shipping tonnage are party to MARPOL, only 39 nations have ratified Annex V.\(^{394}\) The broad support for United States ratification of Annex V from environmental groups, the merchant shipping industry, and the plastics industry suggests that Annex V offers a practical response to the global problem of marine plastics pollution.\(^{395}\) Accordingly, the IMO with the support of the nations that are party to Annex V and the United Nations Environment Programme should encourage all nations party to MARPOL to ratify Annex V. Such efforts could prove successful as nations party to MARPOL have already recognized the need for international solutions to vessel source pollution through their adoption of Annexes I and II.

The United States and other nations party to Annex V should also encourage states offering flags of convenience to ratify Annex V. Liberia, for example, represents more than 13 percent of the world’s gross shipping tonnage and has not ratified the Annex.\(^{396}\) Nations such as

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393. *See* B. Boczek, *Flags of Convenience* 4-5 (1962) (stating that the term “flag of convenience” refers to flags of states that permit the registration and operation of ships with minimum taxation and lower legal standards of social security) (citation omitted). The countries of Panama, Liberia, Honduras, and Costa Rica are considered the main flags of convenience. *Id.*

394. Coast Guard Commandant Instruction, *supra* note 20, enclosure 4. States party to MARPOL that have not yet ratified Annex V are Australia, Brazil, Brunel Darussalam, Bulgaria, Iceland, India, Indonesia, Liberia, Republic of Korea, South Africa, Spain, Switzerland, and the Syrian Arab Republic. *Id.*

395. *See* 133 *Cong. Rec.* H8569 (daily ed. Oct. 13, 1987) (statement of Rep. Studds) (supporting adoption of United States implementing legislation for Annex V). Representative Studds observed that “[T]his is a simple proposal. It reflects good sense, as few do, and it deserves support. The shipping industry supports it, environmentalists support it, the fishing industry supports it, and the Administration supports it.” *Id.*

396. *See* S. REP. No. 100-8, *supra* note 115, at 30-31 (indicating that Liberia
Honduras and Costa Rica should be encouraged to ratify MARPOL, including Annex V, in order to expand regulation of pollution from the world's shipping fleets.\textsuperscript{397}

The jurisdictional reach and effectiveness of Annex V could be greatly expanded by international adoption of the LOS Convention.\textsuperscript{398} First, the LOS Convention requires states to ensure that vessels flying their flag comply with international rules established under the IMO for the prevention and control of pollution.\textsuperscript{399} If ratified, the LOS Convention would require all nations party to the Convention to adopt rules regulating disposal of ship wastes that are no less stringent than Annex V.\textsuperscript{400} The LOS Convention also contains significant jurisdictional provisions that mandate flag and coastal state enforcement of dumping conventions.\textsuperscript{401}

representing 13\% of the shipping tonnage worldwide, has not ratified Annex V). Panama, representing roughly 10\% of the world's shipping tonnage is the only state offering a flag of convenience that has ratified Annex V. \textit{Id.}

\textsuperscript{397} See Coast Guard Commandant Instruction, \textit{supra} note 20, encl. 4 (indicating that, as of February 1989, neither Honduras nor Costa Rica is party to MARPOL).

\textsuperscript{398} See \textit{supra} note 134 (discussing the status of the LOS Convention).

\textsuperscript{399} LOS Convention, \textit{supra} note 129, pt. XII, sec. 6, art. 217, para. 1. The LOS Convention obligates flag states to ensure that vessels under their flag comply with standards established by the IMO and its diplomatic conferences for the prevention regulation and control of pollution. \textit{Id.} Flag states are required to investigate and prosecute violations of IMO standards and regulations irrespective of where the violation occurred. \textit{Id.} art. 217, para. 4; see \textit{J. KINDT, supra} note 119, at 1188 (discussing flag-state enforcement).

\textsuperscript{400} LOS Convention, \textit{supra} note 129, pt. XII, sec. 5, art. 211, para. 2. Article 211 states:

2. States shall adopt laws and regulations for the prevention, reduction and control of pollution of the marine environment from vessels flying their flag or of their registry. Such laws and regulations \textit{shall at least have the same effect as that of generally accepted international rules and standards established through the competent international organization [IMO] or general diplomatic conference.}

\textit{Id.} (emphasis added). Although the exact meaning of "generally accepted international rules" and similar phrases in the LOS Convention has been debated, some observers interpret the language as obligating parties to the LOS Convention to adopt rules and standards in other conventions established through the competent international organization to which the state need not or may not be a party. See, e.g., Boyle, \textit{Marine Pollution Under the Law of the Sea Convention}, 79 Am. J. Int'l L. 347, 356 (1985) (discussing generally accepted rules under the LOS Convention). Some observers argue that a convention must achieve the status of customary law before it can be regarded as setting an international rule or standard. \textit{Id.}

\textsuperscript{401} LOS Convention, \textit{supra} note 129, pt. XII, sec. 6, art. 216. Article 216 states:

\textit{Laws and regulations adopted in accordance with this convention and applicable international rules and standards established through competent international organizations or diplomatic conference for the prevention, reduction, and control of pollution of the marine environment by dumping, shall be enforced:}

a) by the coastal State for dumping within its territorial sea or its exclusive economic zone, or on its continental shelf;

b) by the flag State with regard to vessels flying its flag or vessels or aircraft of
Finally, the LOS Convention establishes port state jurisdiction over ships that violate international discharge standards on the high seas or outside the internal waters, territorial sea, or EEZ of a port state. Accordingly, if ratified, the LOS Convention would permit a nation to undertake investigation and enforcement actions against a vessel voluntarily within the state's ports to determine whether the ship discharged garbage outside the nation's EEZ in violation of Annex V, the applicable international standard. Such enforcement authority would supplement existing flag state enforcement powers for violations on the high seas. Extended port state jurisdiction under Article 218 of the LOS Convention would provide an especially effective enforcement regime if Annex V is amended to require that vessels maintain refuse record books and waste management plans. The LOS Convention

its own registry;

c) by any State with regard to loading of wastes or other matter occurring within its territory or at its off shore terminals.

Id; see J. KINDT, supra note 119, at 1140 (stating that article 216 appears to require international enforcement of the Ocean Dumping Convention (London Dumping Convention) because the Convention is a preexisting, widely accepted agreement established through a competent diplomatic conference). Accordingly, coastal states under the LOS Convention may be bound to enforce the London Dumping Convention even when they are not a party. Id. Enforcement of IMO dumping conventions, such as the London Dumping Convention, through the LOS Convention regime, would significantly increase the jurisdictional reach of such conventions, protecting roughly 33% of the world's oceans. Id.

402. LOS Convention, supra note 129, pt. XII, sec. 6, art. 218, para. 1. Article 218 states:

When a vessel is voluntarily within a port or at an off-shore terminal of a State, that State may undertake investigations and, where the evidence so warrants, institute proceedings in respect of any discharge from that vessel outside the internal waters, territorial sea or exclusive economic zone of that State in violation of applicable international rules and standards established through the competent international organization [IMO] or general diplomatic conference.

Id. (emphasis added); Some commentators consider port state enforcement for violations on the high seas one of the most innovative provisions of the LOS Convention. J. KINDT, supra note 119, at 1,189.

403. See supra note 133 (noting that the IMO is considered the competent international organization). Annex V was drafted under the auspices of the IMO and would constitute the applicable international standard to which vessels on the high seas could be held. Supra note 228 and accompanying text (discussing the development of MARPOL 73/78). Some delegations at the LOS Conference viewed MARPOL as the appropriate international rules under the LOS Convention. Boyle, supra note 401, at 355 (discussing MARPOL relative to the appropriate rules under the LOS Convention) (citing REPORTS OF THE UNITED STATES DELEGATION TO THE THIRD UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA 131-33 (M. Nordquist & C. Park eds. 1983)).

404. See supra notes 278-81 (discussing flag-state enforcement duties with regard to vessel source pollution).

405. See infra notes 407-12 (discussing the need for international requirements for refuse record books).
also requires states to provide technical and scientific assistance to developing countries either directly or through international organizations. Such requirements could facilitate the transfer of degradable and recyclable plastics technology to lesser developed countries.

B. INTERNATIONAL REQUIREMENTS FOR REFUSE RECORD BOOKS AND WASTE MANAGEMENT PLANS

Nations party to Annex V must recognize the jurisdictional limitations on enforcement actions and amend Annex V to require maintenance of refuse record books and waste management plans. The United States and Norway, for example, already require log entries for the discharge of ship-generated wastes. Waste tracking and handling requirements for the world's shipping fleets, although not capable of documenting the loading or disposal of all plastics, could track much of the packaging, sheeting, and dunnage used by ships to ensure its proper disposal. Failure to properly document waste log books or maintain waste management plans could serve as a rebuttable presumption that a violation of Annex V occurred. The recordkeeping requirements

406. LOS Convention, supra note 119, pt. XII, sec. 3, art. 202. The LOS Convention directs states to promote scientific, education, and technical programs for developing states that concern the prevention and control of marine pollution. Id.

407. See supra notes 277-83 and accompanying text (discussing enforcement and jurisdiction under Annex V).

408. See MPPRCA § 2107, 33 U.S.C. § 1903(b)(2) (Supp. V 1987) (requiring the Coast Guard to promulgate regulations requiring ocean-going vessels to maintain refuse record books, waste management plans, and notice placards of Annex V requirements for passengers and crew); supra note 310 (discussing proposed rules).

409. See Regulations Concerning the Prevention of Pollution from Ships, Ch. V § 5-7 (June 16, 1983) (stating "[i]n ships where a deck log shall be kept, appropriate entries concerning the disposal of ship's garbage shall be made"). Chapter V concerning the prevention of pollution by garbage from ships entered into force on April 1, 1989. Letter from Mette Kongshem, Counselor of the Royal Norwegian Embassy to Paul Hagen (Apr. 10, 1989) (discussing Norwegian implementing legislation for Annex V and providing copies thereof)(copy on file with the office of the American University Journal International Law & Policy). Mobile installations are also required to make entries concerning the disposal of garbage in relevant record books. Id.

410. See Notice of Proposed Rulemaking for Annex V Regulations, 53 Fed. Reg. 43,622, 43,643 (1988) (to be codified at 33 C.F.R. § 151.63(b)) (stating that if a master or person in charge of a ship is unable to demonstrate that plastics are not used aboard the ship or comply with Annex V handling options for plastics, a violation of Annex V will be presumed). The interim rule removed this presumption, but the Coast Guard is still considering it as a means of promoting compliance. Interim Regulations for Annex V of MARPOL 73/78, 54 Fed. Reg. 12,389 (1989). The use of presumptions is not new under United States law. Anderson, Natural Resources Damages, Superfund, and the Courts, 16 B.C.L. REV. 405 (providing a detailed discussion of Superfund's rebuttable presumption for natural resource damage claims). In addition to Superfund, numerous state workers' compensation laws and the federal Coal Mine Health and Safety Act of 1969 for persons suffering from Black Lung disease also
would increase awareness of Annex V requirements among vessel crews and provide an effective instrument for enforcement.\footnote{411}{See Hearings on H.R. 940, supra note 49, at 455 (statement of Sally Ann Lentz, on behalf of the Entanglement Network)(stating that management plans and garbage record books would ensure consideration of compliance options and facilitate enforcement).}

Absent an amendment to Annex V, member nations should follow the lead of the United States and Norway by imposing recordkeeping requirements on vessels under their own flag. Unilateral adoption of such requirements could facilitate international approval of a similar amendment to Annex V.\footnote{412}{See Report on the Act to Prevent Pollution from Ships, supra note 163, at 4,849 (noting that Congress viewed amendments to the Tanker Safety Act in 1980 that imposed reception facility requirements on United States ports as a means of materially influencing other maritime nations to ratify MARPOL).}

Parties to MARPOL should also amend Annex V to require a deadline on which all major international ports must be in compliance with minimum waste handling requirements as set out in the MEPC draft guidelines.\footnote{413}{See MEPC/25 Draft Guidelines, supra note 265, at para. 6.1 (setting forth guidelines for port reception facilities pertaining to garbage).}

\textbf{C. INCREASED INTERNATIONAL REGULATION OF COMMERCIAL FISHING}

Parties to Annex V should amend the Annex to impose strict liability on all fishing vessels for the loss of synthetic fishing gear.\footnote{414}{See Fjelstad, supra note 98, at 696 (proposing strict liability for lost nets similar to the liability for unintentional violations of the Migratory Bird Treaty Act). Fines could be based on the size of the net, whether marine life was taken, and the time between loss and recovery of the net. Id.} Such an amendment could define factors for assessing fines and also require states of registry to issue "certificates of adequacy" for all commercial fishing vessels of a certain size similar to certificates used in Annexes I and II. The certificates would certify the type of synthetic gear being used and that the gear is marked so as to permit identification for an agreed upon period of time. An amendment to Annex V need only set forth the principle of strict liability for lost fishing gear, factors for assessing fines, and the minimum marking requirements. Individual nations could meet these requirements individually or work within regional fishery agreements to address the specific needs and gear characteristics within particular fisheries. Fishing vessels could be required to maintain log books on equipment used and consequent losses in accordance with such regulations. Such a requirement would facilitate the enforcement of the new regulations and ensure that the visceral losses were accurately recorded and assessed.
PLASTICS POLLUTION
dance with the certificates. The use of unapproved, unlogged, or un-marked equipment could constitute a violation of Annex V.

Strict liability and certificates of adequacy for commercial fishing vessels would deter careless handling and the discharge of gear, while encouraging retrieval efforts. Similarly, the MEPC of the IMO should encourage states to adopt reporting requirements for the loss of synthetic gear both to develop a data base on such losses and to encourage others to retrieve such gear for either recycling or bounty awards. Such amendments would avoid the difficulty of determining whether "reasonable precautions" were taken to avoid the loss of fishing gear. Routine inspections of United States and foreign vessels by the United States Fisheries Service and United States Coast Guard could ensure proper gear use, marking, and reporting.

Fishery conservation agreements and United States domestic law should also encourage the use of degradable materials in the construction of fishing nets and crab traps in order to accelerate the breakdown of lost or discarded gear. Requiring a permit and fee for the use of synthetic gear could make natural fibers economically competitive, thereby encouraging their use. In addition, such gear could be exempt from the strict liability requirements under any such amendment to Annex V. The use of bio or photodegradable plastic materials, however, should be encouraged only after careful study determines that the use of such plastics does not transform the entanglement problem into one of ingestion.

D. INTERNATIONAL PROHIBITION ON ASH DISPOSAL AT SEA

The United States and other nations party to Annex V should review the potential environmental hazards associated with shipboard incinerator emissions and at sea disposal of incinerator ash. Similar to Annex V's prohibition on plastics disposal, parties to MARPOL should adopt similar amendments prohibiting the disposal of incinerator ash at

415. Reporting requirements for the release of hazardous materials are common. See, e.g., CERCLA, 42 U.S.C. § 9603 (1982 and Supp. IV 1986)(requiring persons in charge of vessels or facilities to notify the national response center upon knowledge of a release of a hazardous substance); Clean Water Act, 33 U.S.C. § 1321 (b)(B)(5)(1982)(requiring any person in charge of a vessel or facility to notify the appropriate government agency upon knowledge of a discharge of oil or hazardous substance). See generally United States and International Authorities Applicable to En-tanglement, supra note 125, at 18 (proposing a systemized gear inventory system under the Fishermen's Protective Act, 22 U.S.C. §§ 1971-1980 (1982)). Such amendments to the Fishermen's Protective Act could be a useful tool in determining the amount of fishing gear entering the marine environment. Id.
The amendments should also establish stringent and universal performance and construction standards for shipboard incinerators in order to minimize the release of emissions containing heavy metals, dioxin, and acidic gases into the marine environment. Limits should also be placed on the rate and toxicity of incinerator emissions at sea. Similar to Annex III requirements concerning noxious liquid substances, international recordkeeping and tracking procedures for incinerator ash should be established under Annex V to ensure the proper disposal of ash from vessels using on board incinerators.

A total ban on the incineration of incidental wastes would appear to be in concert with recent decisions of nations party to the London Dumping Convention and the Oslo Convention to ban the practice of at sea incineration by 1994. Similarly, recent adoption of the Basel Convention concerning the transboundary shipment of hazardous waste indicates a growing international awareness of the dangers of hazardous waste and suggests possible support for at least prohibiting at sea disposal of incinerator ash. Like the problem of plastics pollution itself, an international approach is needed to adequately address the pollution threat to marine waters resulting from increased incineration at sea.

416. See MARPOL Convention, supra note 19, Annex V, reg. 3 (banning the disposal of plastics into marine waters). Additionally, the MEPC should promulgate efficiency and emission standards for shipboard incinerators in its Draft Guidelines to prevent both air and sea contamination through emissions and fly ash. Cf. Draft MEPC/25 Draft Guidelines, supra note 264 (placing no efficiency and emissions standards on shipboard incinerators).

417. Precedence for international construction and performance requirements can be found in the provisions of Annex I to MARPOL governing construction of oil tankers. See MARPOL Protocol, supra note 19, Annex I, regs. 13, 18 (requiring certain oil tankers to be constructed with segregated ballast tanks and pumping, piping, and discharge equipment that minimize oil retention).

418. See MARPOL Convention, supra note 19, Annex I, reg. 9 (establishing discharge limits and rates for oil which could serve as a model for regulation of emissions from ships).

419. See id. Annex III, reg. 9 (requiring all ships transporting noxious liquid substances to maintain a Cargo Record Book on a tank-to-tank basis).


421. BASEL CONVENTION, supra note 387. Cadmium, which is often found in incinerator residue, is already recognized as a threat to marine resources and is among the London Dumping Convention's list of extremely dangerous substances that cannot be discharged under dumping regulations. Supra note 121 (listing Annex I substances under the London Dumping Convention).
E. INCREASED USE OF DEGRADABLE PLASTICS AND RECYCLING

Nations party to Annex V should promote the recycling of all types of plastics at all ports in order to lessen the costs of compliance with Annex V.\footnote{See New Uses for Plastics, 1 WORLD WASTES 23 (Jan. 1988) (discussing the uses of Syntal, a recycled plastic product that has uses similar to lumber). Annual projected compliance costs for vessels in the United States alone is roughly $41.7 million, apportioned as follows: $2.9 million for merchant fishing, $33.9 million for commercial fishing, $1.4 million for recreational boating, $900,000 for offshore oil and gas operations, $400,000 for miscellaneous vessels and $2.2 million for ports. REGULATORY EVALUATION OF ANNEX V, supra note 6, at 6.} Moreover, the IMO should establish procedures for the transfer of recycling and degradability technology relating to plastics,\footnote{See Degradable Plastics—Standards, Research and Development, supra note 4, at 10 (stating that photodegradation and biodegradation are the most common means of degrading plastics). Photodegradation relies on the sun’s ultraviolet rays to break up the physical and chemical composition of plastic. Id. Biodegradation relies on microorganisms to break down the plastic. Id.; see also Degradable Plastics Show Promise in Fight Against Trash, N.Y. Times, Apr. 11, 1989, at CI (providing an overview of degradable plastics and noting that 16 states require six pack yokes to be degradable). The ability of plastics to quickly and completely break down through biodegradation is uncertain. Chemistry of Plastics Casts a Negative Vote, MODERN PLASTICS, Aug. 1989, at 48 (noting that plastics can be more easily made photodegradable than biodegradable). Degradable plastics, however, may not be compatible with recycling technology. Id.} especially plastics relating to maritime uses. Presently, the plastics industry lags far behind other industries in the area of recycling.\footnote{See, e.g., Second Life for Styrofoam, TIME, May 22, 1989, at 84 (stating that less than 1% of all plastic is recycled as compared with 25% of all aluminum). Three major plastic resin suppliers, Du Pont, Goodyear, and Amoco have recently announced plans to begin plastic recycling programs. As Recycling Gains Momentum, More Resin Suppliers Get into the Action, MODERN PLASTICS, June 1989, at 170.} Accordingly, the United States and other states should create incentives for recycling plastics through the imposition of taxes on plastics that cannot be recycled and granting tax breaks for plastics that can be recycled.\footnote{See Key Role for Additives: Upgrade Polymer Recycle, MODERN PLASTICS, Oct. 1988, at 85 (stating that the use of additives can increase the performance value of reclaimed plastics). The Toxic Substances Control Act may provide the EPA with authority to require special additives that enhance the recyclability of certain plastics. Supra note 207-08. See, e.g., H.R. 500, 101st Cong., 1st Sess., 135 CONG. REC. E 657 (daily ed. Mar. 6, 1989)(introduced by Rep. Hochbruekner) (encouraging scientific research and development of technologies pertaining to the recycling of plastics). H.R. 500 seeks to establish an office of Recycling Research and Information. Id. § 6. The bill proposes grants for research into recycling of nondegradable materials. Id. § 6(c)(3); see also H.R. 3463, 101st Cong., 2d Sess., 135 CONG. REC. H7042 (daily ed.} Developed nations should assist the plastics industry in establishing demonstration projects at ports for recycling and encourage the development of recyclable plastic products for consumer and maritime use.\footnote{See, e.g., H.R. 500, 101st Cong., 1st Sess., 135 CONG. REC. E 657 (daily ed. Mar. 6, 1989)(introduced by Rep. Hochbruekner) (encouraging scientific research and development of technologies pertaining to the recycling of plastics). H.R. 500 seeks to establish an office of Recycling Research and Information. Id. § 6. The bill proposes grants for research into recycling of nondegradable materials. Id. § 6(c)(3); see also H.R. 3463, 101st Cong., 2d Sess., 135 CONG. REC. H7042 (daily ed.} In the United States, for example, government agencies,
public interest groups, and the plastics industry have already successfully cooperated in establishing educational campaigns relating to marine plastics debris.\(^{427}\)

The United States should also adopt laws similar to House Resolution 5117\(^{428}\) that bans nondegradable plastic beverage ring carriers, in an effort to encourage the use of more readily degradable or recyclable packaging materials. Similarly, state and local governments must not overlook their powers to require degradable materials for fishing gear\(^{429}\) and their ability to ban synthetic fishing gear and particular consumer items or packaging that contribute to marine pollution.\(^{430}\) The United


427. See, e.g., SOCIETY OF THE PLASTICS INDUSTRY, PLASTICS AND MARINE DEBRIS—SOLUTIONS THROUGH EDUCATION (March 1989) (discussing the educational campaign aimed at reducing the discharge of wastes from ships that the Society for the Plastics Industry, the Center for Marine Conservation, and the National Ocean and Atmospheric Administration coordinated). The Board of Directors of the Society for the Plastics Industry adopted a policy statement on September 1987 that supported United States ratification of Annex V, committing the Society to resolving issues of plastic pellet discharges and to furthering educational efforts. Id. at 3.

428. H.R. 51,175, 100th Cong., 2d Sess., 134 CONG. REC. H9529 (July 28, 1988) (banning nondegradable plastic ring holders within two years of the enactment of the bill).

429. See, e.g., ME. REV. STAT. ANN. tit. 12 § 6433-A (1988)(requiring all lobster traps to be equipped with a biodegradable ghost panel designed to release lobsters from lost traps); V.I. CODE ANN. tit. 12 § 319(h) (1988) (requiring traps and pots to contain an opening covered with untreated fiber of biological origin or non-galvanized sixteen gauge black iron wire).

430. See Suffolk County, N.Y. Local Law no. 10 simplifying solid waste management by requiring certain uniform packaging practices within the county of Suffolk (1988) (on file at the office of the American University Journal of International Law and Policy) (banning the use of items such as plastic grocery bags, styrofoam cups, meat trays, and similar nonbiodegradable food packaging originating in retail establishments in answer to increased limits in landfilling capacity). Although the Suffolk County law banning the use of non-biodegradable packaging received nation-wide media attention, the law was stayed pending the preparation of an Environmental Impact Statement in accordance with state law. Society for the Plastics Industry v. The County of Suffolk, No. 88-11262 (Sup. Ct. N.Y. June 2, 1989). See also Is Minneapolis’ Anti-Plastics Law a Blueprint for the Future?, MODERN PLASTICS, May 1989, at 10 (stating “Suffolk County, New York was tough; Minneapolis is tougher” in describing recent bans on plastic packaging). Both Suffolk and Minneapolis have passed ordinances that ban the use of plastic carry-out bags, and related food packaging that is not degradable. Id. In 1988 and 1989, legislatures throughout the United States introduced some 400 bills regulating the use of plastic packaging. Recycling Programs Proliferate as Industry Faces Tangle of Taxes and Bans, MODERN PLASTICS, May 1989, at 100. Local governments should use the option to ban plastics in an effort to encourage the plastics industry to establish pilot recycling facilities within their jurisdictions. Following the adoption of legislation in Suffolk County banning the use of certain plastics for consumer items, Amoco corporation constructed a demonstration recycling plant in Brooklyn, New York to recycle wastes from 19 McDonald’s restaurants. Plastic Trash: Silk Purses Sought, N.Y. Times, May 3, 1989, at D1.
States Supreme Court in *Minnesota v. Clover Leaf Creamery Co.*\(^1\) upheld a Minnesota law banning the use of plastic gallon milk containers, basing its decision on the validity of the state’s environmental and conservation concerns. Moreover, the effectiveness of state regulation over fishing practices in state marine waters may soon be increased by an extension of the territorial sea from three to twelve miles.\(^2\)

**CONCLUSION**

Ratification of Annex V of the MARPOL Convention represents a significant international effort to prevent plastics pollution of the world’s marine waters. The global regime established under Annex V for the prevention of plastics pollution places enforceable duties not only on nations and industries, but also upon individuals stewarding vessels into marine waters under flags of thirty-nine nations around the world.\(^3\) In this respect, Annex V represents an important step for the international community which faces a broad range of transboundary environmental problems.\(^4\)

Although Annex V will not eliminate marine plastics pollution,\(^5\) it will significantly reduce such pollution from ships, both through enforcement of its regulations and through greater education.\(^6\) Increased awareness of the hazards of plastics in the marine environment

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\(^2\) *See Extension of U.S. Territorial Sea*, 20 MAR. POLLUT. BULL. 57 (1989) (stating that the United States is considering an extension of the territorial sea from 3 to 12 miles). The proposed extension would likely give states broader jurisdiction over waters beyond the current three mile limit for state jurisdiction because the states could claim the enlarged coastal zone. *Id.*

\(^3\) *See supra* note 20 (listing states that have ratified Annex V).


\(^5\) *See supra* notes 45-48 and accompanying text (discussing land-based sources of plastic debris).

\(^6\) *Nat’l Ocean Policy Study Hearings*, supra note 4, at 16 (statement of Rear Admiral J. William Kime, United States Coast Guard) (borrowing an expression from the New Jersey Department of Environmental Protection and stating that the elements to solving the garbage problem at sea are the "three E’s": engineering, education, and enforcement).
should accompany Annex V world-wide. \footnote{See MEPC/25 Draft Guidelines, supra note 265, at para. 2 (recommending that nations institute training, education, and information programs to ensure a successful fight against marine plastics pollution); see also P. Debenham, \textit{Education and Awareness: Keys to Solving the Marine Debris Problem} (1989) (presented at the Second International Conference on Marine Debris, Honolulu, Hawaii, Apr. 2-7, 1989) (stating that several international conferences have emphasized the need for educational programs to address the marine debris problem, including the 1984 International Conference on the Fate and Impacts of Marine Debris, the North Pacific Rim Fishermen's Conference on Marine Debris, and the Oceans of Plastic Fishermen's Workshop). Noting the difficulty in enforcing international and national legislation relating to marine plastics pollution, the Center for Marine Conservation has developed educational campaigns, publications, and hands-on educational events such as Coastweeks '88 beach cleanups in an effort to prevent the discharge of debris. \textit{Id.}}

Significant work remains for both individual nations and the IMO in broadening the jurisdiction of Annex V and amending it to facilitate enforcement and limit the hazards of at sea incineration. The United States, which waited for over fifteen years to ratify Annex V, now has the opportunity to lead nations in promulgating effective domestic regulations and proposing amendments to MARPOL that address unresolved environmental and enforcement difficulties. The dedication and success of these efforts may well determine the long-term effectiveness of Annex V in limiting the global economic and environmental impacts of marine plastics pollution.