

Plastic, the Great Pacific Garbage Patch, and International Misfires at a Cure

*Grant A. Harse**

I. INTRODUCTION.....	331
II. BACKGROUND	333
A. <i>The Current State of the Pacific Ocean</i>	333
1. Plastics and Their Effect on the Marine Environment and Human Health	334
2. The Papahanaumokuakea Marine National Monument	342
B. <i>Current International Water Quality Conventions and National Ocean Water Quality Statutes</i>	344
III. PROPOSAL: INTERNATIONAL OCEANIC DEBRIS PREVENTION AND REDUCTION AGREEMENT	354
IV. CONCLUSION	360
V. APPENDIX A: MAP OF THE PAPAHAUUMOKUAKEA MARINE NATIONAL MONUMENT	361
VI. APPENDIX B: MIGRATION OF PLASTICS IN THE GPGP OVER 10 YEARS	362

I.

INTRODUCTION

Plastic and synthetic debris in the oceans have a profoundly negative effect on the lives of marine animals, plants, birds, and ultimately humans. As this form of pollution endangers the quality of ocean water, it likewise reduces the quantity of water suita-

* Attorney, Kansas Department of Health and Environment; J.D., University of Kansas School of Law, May 2010; B.B.A., Belmont University, May 2003. The author wishes to thank Burke W. Griggs for his guidance and feedback, the editorial staff of the UCLA Journal of Environmental Law and Policy for their work in preparing this article for publication, and his family for their unwavering support.

ble for life.¹ This has a disastrous effect on the quality and quantity of resources provided by the planet's oceans. One particularly chilling example of the effects of plastic is found in "the world's largest landfill," located in the central Pacific Ocean: the Great Pacific Garbage Patch ("GPGP").²

There are currently several international treaties and agreements that target some of the causes of the GPGP. Nonetheless, these treaties and agreements are only as strong as the laws of the member states. It is up to a member state to regulate and prosecute illegal activities within its waters, or in some instances, to prosecute acts done by vessels sailing under its flag. Recognizing that "[u]nregulated dumping of material into ocean waters endangers human health, welfare, and amenities, and the marine environment, ecological systems, and economic potentialities,"³ the United States has passed a number of statutes to prevent and remediate ocean dumping, both as a national matter and pursuant to its responsibilities under those international agreements to which it is a signatory. In spite of these bodies of law, the primary cause of the GPGP is ignored: land-based sources. To truly reverse the course of the GPGP, the world's nations need to strengthen their domestic water quality and solid waste disposal laws in order to prevent the introduction of plastic debris into national waterways, such as rivers, streams and canals. As will be discussed, it is these waterways that ultimately deliver the vast majority of plastics to our oceans.

This article will begin with an examination of the current state of the Pacific Ocean and its pollution levels. Specifically, the causal nexus between plastic and oceanic pollutants will be discussed, with particular attention paid to the Papahānaumokuā-

1. There are approximately 326 million trillion gallons of water on our planet, covering approximately 70% of the surface. See *How Much Water is There?*, U.S. GEOLOGICAL SURVEY, <http://ga.water.usgs.gov/edu/earthhowmuch.html> (last visited Aug. 10, 2011). Approximately 96.5% of that water is in the oceans, meaning only about 4% is drinkable fresh water. *Id.* Of the world's *fresh* water, nearly 70% is trapped in the polar ice caps or glaciers. *Id.* Approximately 0.76% of the world's water is in underground aquifers, while roughly 0.007% is in lakes and rivers. *Id.* The rest of the water on the planet is either floating in the air as clouds and water vapor, is temporarily locked up in plants, animals, and products, or is in transition. *Id.* Because the earth's water is essentially static, as more of our water is polluted, there is necessarily less "clean" water.

2. CAPTAIN CHARLES MOORE, ALGALITA MARINE RESEARCH FOUND., OUT IN THE PACIFIC PLASTIC IS GETTING DRASTIC: THE WORLD'S LARGEST "LANDFILL" IS IN THE MIDDLE OF THE OCEAN (2002) (citation omitted), available at http://marine-litter.gpa.unep.org/documents/World%27s_largest_landfill.pdf.

3. 33 U.S.C. § 1401(a).

kea Marine National Monument.⁴ This article will then survey the national and international oceanic water quality laws and agreements already in place, and identify the weaknesses and strengths of each. Finally, this article will propose possible changes to the Federal Water Pollution Control Act,⁵ commonly known as the Clean Water Act, and the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act,⁶ to halt the GPGP's growth and the general accumulation of plastic oceanic debris.

II. BACKGROUND

A. *The Current State of the Pacific Ocean*

The Great Pacific Garbage Patch is an area of marine debris concentration in the North Pacific Ocean,⁷ comprised of the North Pacific Subtropical High ("PSH"),⁸ which is located between California and Hawaii, and the "recirculation gyre," which is located off the coast of Japan.⁹ The PSH and "recirculation gyre" are connected by the North Pacific Subtropical Convergence Zone ("STCZ"),¹⁰ which is located along the southern edge of an area known as the North Pacific Transition Zone.¹¹ Within this zone, "[a] huge mountain of air, which has been heated at the equator . . . descend[s] in a gentle clockwise rotation as it approaches the North Pole . . ."¹² These circular winds create the North Equatorial Current, the Kuroshio Current, the

4. The Monument's former name, the Northwestern Hawaiian Islands Marine National Monument, was changed to its current name on March 3, 2007. See D. Kapua Sproat & Aarin F. Goss, *The NW. Hawaiian Islands Marine National Monument*, 22 NAT. RES. & ENV'T 57, 58 (Spring 2008).

5. 33 U.S.C. §§ 1251-1387.

6. 42 U.S.C. §§ 6901-6992k.

7. Nat'l Oceanic & Atmospheric Admin., *De-mystifying the "Great Pacific Garbage Patch"*, MARINE DEBRIS, <http://marinedebris.noaa.gov/info/patch.html#1> (last updated Sept. 18, 2010); See also Jacob Silverman, *Why is the World's Largest Landfill in the Pacific Ocean?*, HOWSTUFFWORKS.COM, <http://science.howstuffworks.com/environmental/earth/oceanography/great-pacific-garbage-patch.htm>.

8. Nat'l Aeronautics and Space Admin., *supra* note 7. This location is known as the Eastern Garbage Patch. *Id.*

9. *Id.* This area is known as the Western Garbage Patch. *Id.*

10. See NAT'L OCEANIC & ATMOSPHERIC ADMIN., *supra* note 7.

11. *Id.*

12. MOORE, *supra* note 2.

North Pacific Current and the California Current,¹³ all “which spiral into a center where there is a slight down-welling,”¹⁴ known as the North Pacific Subtropical Gyre.¹⁵ These currents also contribute to smaller eddies and convergence zones, including the PSH and STCZ.

For centuries, these areas have acted as a sort of garbage disposal for the Pacific. “Anything that floats, no matter where it comes from on the north Pacific Rim or ocean, ends up [there], sometimes after drifting around the periphery for twelve years or more.”¹⁶ Historically, because these wastes were ultimately comprised of natural—rather than synthetic—substances, they would eventually break down into carbon dioxide and water due to biodegradation.¹⁷ “Now, however, in our battle to store goods against natural deterioration, we have created a class of products that defeats even the most creative and insidious bacteria. They are plastics.”¹⁸ As a result, wastes that do not readily biodegrade now collect within the Pacific at an alarming rate.

1. Plastics and Their Effect on the Marine Environment and Human Health

Plastics are now virtually everywhere in our modern society. We drink out of them, eat off of them, sit on them, and even drive in them. They’re durable, lightweight, cheap, and can be made into virtually anything. But it is these useful properties of plastics, which can make them so harmful when they end up in the environment. Plastics, like diamonds, are forever!¹⁹

The term “plastic” encompasses a large group of incredibly versatile products, including approximately 20 groups of plastics.²⁰ Inexpensive to manufacture, plastics are also lightweight, strong, durable, corrosion-resistant, and have high thermal and

13. Nat’l Aeronautics and Space Admin., *Wind Driven Surface Currents: Gyres Background*, OCEAN MOTION, <http://oceanmotion.org/html/background/wind-driven-surface.htm> (last visited May 5, 2010).

14. MOORE, *supra* note 2.

15. Nat’l Oceanic & Atmospheric Admin., *supra* note 7.

16. MOORE, *supra* note 2.

17. *Id.*

18. *Id.*

19. *Id.*

20. Richard C. Thompson et al., *Our Plastic Age*, 364 PHIL. TRANSACTIONS ROYAL SOC’Y B. 1973, 1973 (2009). Of these, low-density polyethylene, high-density polyethylene, polyvinyl chloride, polystyrene, and polyethylene terephthalate account for nearly 90% of world plastic material demands. Anthony L. Andrady & Mike A. Neal, *Applications and Societal Benefits of Plastics*, 364 PHIL. TRANSACTIONS ROYAL SOC’Y B. 1977, 1977 (2009).

electrical insulation properties.²¹ Nearly every aspect of daily life involves plastics or rubber in some form. Their varied uses include clothing and footwear; food, medicine, and public health applications; packaging; vehicles; and building materials.²² As a result, the world-wide demand for plastics was expected to have reached 308 million tons in annual use by 2010.²³

Unfortunately, the ubiquitous nature of plastic is having an adverse affect on the planet's oceans and life. Unlike other forms of refuse dumped at sea or in our landfills, most plastics break down very slowly; of these plastics, water-bound plastics take the longest to degrade.²⁴ Rather than breaking down into different chemical constituents, most plastics "break into smaller and smaller pieces, eventually becoming individual polymer molecules, which must undergo further degradation before becoming bioavailable. The eventual biodegradation of plastics in the marine environment requires an unknown amount of time," though the time needed for complete biodegradation of marine plastic is estimated to be several centuries.²⁵

The oceans are downhill and thus downstream from almost everywhere humans live. Indeed, 50% of the world's human population lives within 50 miles of the ocean.²⁶ As a result, it is fairly easy for plastics to make the short trip into the sea.²⁷ Plastics used in food and drink packaging are often left by recreational users of beaches and coastal waters.²⁸ The fishing industry's use of plastic "has resulted in substantial amounts of derelict fishing debris in ocean waters and on beaches."²⁹ Inland urban areas contribute significantly to this problem, as lightweight plastics reach the ocean via storm drainage systems that discharge into rivers and the sea.³⁰ Indeed, as much as 80% of marine debris is estimated to be from land-based sources. This

21. Thompson et al., *supra* note 20.

22. Andrady & Neal, *supra* note 20, at 1980.

23. *Id.* at 1977.

24. Peter G. Ryan et al., *Monitoring the Abundance of Plastic Debris in the Marine Environment*, 364 PHIL. TRANSACTIONS ROYAL SOC'Y B. 1999, 1999 (2009).

25. Charles James Moore, *Synthetic Polymers in the Marine Environment: A Rapidly Increasing, Long-Term Threat*, 108 ENVTL. RESEARCH 131, 132 (2008).

26. *Id.*

27. *Id.*

28. MICHELLE ALLSOPP ET AL., GREENPEACE, PLASTIC DEBRIS IN THE WORLD'S OCEANS 9-10 (2006), available at http://www.unep.org/regionalseas/marinelitter/publications/docs/plastic_ocean_report.pdf.

29. *Id.* at 9.

30. *Id.* at 10.

includes storm water discharges, combined sewer overflows, littering, solid waste disposal sites and landfills, and industrial activities.³¹ Conversely, deliberate disposal of waste or other matter at sea is estimated to account for less than 10% of all ocean pollution.³² The plastic that makes its way to the ocean becomes floating debris, seafloor debris, or shoreline debris.³³

The implications of plastic in our oceans are numerous, but each is significantly important. Discussed below, these implications include aesthetic, environmental, human health, and commercial considerations. Aesthetically, plastic debris tends to collect and concentrate along shorelines and beaches. These beaches are often culturally significant because they are important recreational sites for the communities they serve.³⁴ In addition, marine and terrestrial-originating plants can accumulate along high-tide strandlines, which tend to accumulate significant quantities of plastic and other manufactured, non-destructible materials.³⁵ This results in concerns of economic loss, health issues, harm to the local ecosystem and its participants,³⁶ and expensive clean-up activities.³⁷

The environmental implications of plastic and other manufactured wastes in our oceans are alarming due to the direct affects these substances can have on marine life. In particular, plastic affects marine life by way of ingestion, entanglement, smothering, and by aiding in the introduction of invasive species.

Over 250 species have been identified as affected by ingestion of and entanglement in plastic materials. These species include “turtles; penguins; albatross, petrels and shearwaters[,] shorebirds, skuas, gulls and auks; coastal birds other than seabirds; baleen whales, toothed whales and dolphins; earless or true seals, sea lions and fur seals; manatees and dugong; sea otters, fish, and crustaceans.”³⁸ For example, sea birds and marine vertebrates are known to ingest plastic pellets, bottle caps, pieces of toys, and

31. *Id.* at 11–12.

32. Alan Sielen, *The New International Rules on Ocean Dumping: Promise and Performance*, 21 *GEO. INT’L ENVTL. L. REV.* 295, 297 (2009).

33. ALLSOPP ET AL., *supra* note 28, at 7.

34. Murray R. Gregory, *Environmental Implication of Plastic Debris in Marine Settings-Entanglement, Ingestion, Smothering, Hangers-On, Hitch-Hiking, and Alien Invasions*, 364 *PHIL. TRANSACTIONS ROYAL SOC’Y B.* 2013, 2014 (2009).

35. *Id.* at 2017.

36. *Id.* at 2014.

37. *Id.* at 2017.

38. *Id.* at 2014. Consumption of plastics by marine animals has been recorded as far back as the early 1960s. *Id.* at 2016.

cigarette lighters, among other plastic products.³⁹ Sea turtle species are likewise known to “feed on” “discarded and semi-inflated, floating plastic bags, which are mistaken for jelly fish.”⁴⁰ Entanglement occurs when marine animals are ensnared in netting, ropes, and abandon monofilament lines. Ingestion of and entanglement in plastics can result in “wounds (internal and external), suppurate[ed] skin lesions and ulcerat[ed] sores; blockage of digestive tract followed by satiation, starvation and general debilitation often leading to death; reduction in quality of life and reproductive capacity; drowning and limited predator avoidance;” and interrupted feeding.⁴¹ Additionally, as will be explained in greater detail *infra*, the plastic pellets ingested by these species may adsorb and concentrate potentially damaging toxic compounds from sea water, only to release these toxins into the tissue of the consumer.⁴²

Smothering is another concern, as floating plastic and settled plastic can edge out plankton and the species that feed on it. On the ocean’s surface, small plastic bits accumulate, and in the GPGP, specifically, plastics have been found at exceptionally high levels.⁴³ One study from 1999 found an average of 334,271 pieces of plastic per km², with a mean mass of 5114 g/km².⁴⁴ Plankton in this same area was found at an average of 1,837,342 organisms per km², with a mean mass of 841 km²,⁴⁵ or a plastic to plankton ratio of 6:1, by weight. At the time of the 1999 study, “[t]he mean abundance and weight of plastic pieces calculated [were] the largest observed in the North Pacific Ocean,” and concentration of plastic is believed to be increasing.⁴⁶ As of 2008, this area was found to have a plastic to plankton ratio of 46:1, by weight.⁴⁷ This means that from the dawn of mass-produced

39. See, e.g., *Plastic Waste Creating Ocean-Sized Crisis*, KTVU.COM (Nov. 13, 2006, 9:09 PM), <http://www.ktvu.com/news/10312783/detail.html>; see also Gregory, *supra* note 34, at 2015–17.

40. Gregory, *supra* note 34, at 2017.

41. *Id.* at 2014, 2015–16.

42. *Id.* at 2016. See *infra* text accompanying notes 76–84.

43. See C. J. Moore et al., *A Comparison of Plastic and Plankton in the North Pacific Central Gyre*, 42 MARINE POLLUTION BULL. 1297, 1297 (2001).

44. *Id.* at 1298.

45. *Id.*

46. *Id.* at 1299.

47. Nell Greenberg, *Captain Charles Moore Talks Trash*, EARTH ISLAND J., http://www.earthisland.org/journal/index.php/eij/article/charles_moore/ (last visited Aug. 10, 2011).

plastic to today—some 70 years⁴⁸—this region of the ocean has gone from zero plastic to the significant out-weighting of plankton by plastic. More importantly, plastic, by weight, increased nearly eightfold in less than ten years, after taking approximately 60 years to reach its 1999 levels. Once plastic reaches the sea floor, it is “doomed to a slow and yet permanent entombment.”⁴⁹ This is because the UV exposure and warmer temperatures necessary for biodegradation of plastic⁵⁰ is unavailable, particularly in deeper waters.⁵¹ Because filter-feeding animals cannot distinguish between plankton and plastic,⁵² settlement arguably encourages ingestion of plastic by bottom-dwelling, filter-feeders.

Finally, marine plastic debris allows for the introduction of alien species that may prove to be invasive. Although floating debris of any kind may already provide for the introduction of invasive species, “[p]elagic plastic items are commonly colonized by a diversity of encrusting and fouling epibionts,” including barnacles, tube worms, foraminifera, coralline algae, hydroids, and bivalve mollusks.⁵³ “Aggregations of marine debris can provide habitats suiting the larval and juvenile stages of numerous marine organisms. They may also attract free-living, ocean-roaming predators that often gather under fish aggregating devices, and where others simply sought a protective haven.”⁵⁴

While the effects of plastic on the marine ecosystem are arguably worthy of attention due to their imposition on the environment, the dangers to human health caused by plastic in the oceans are likely most important to consider. It is well documented that humans are exposed to many man-made chemicals.⁵⁵ One relevant class of chemicals, known as endocrine disrupting/modulating chemicals (“EDCs”), has been the subject

48. See Thompson et al., *supra* note 20. Although the first synthetic polymer was developed in 1907, plastics were not mass-produced for everyday items until the 1940s and 1950s. *Id.*

49. Gregory, *supra* note 34, at 2017.

50. Ryan et al., *supra* note 24.

51. *Id.*

52. Moore et al., *supra* note 43, at 1297. It should be noted that the effects of smaller plastics, which have the greatest ability to affect filter-feeders, reduce at increasing depths. *Id.* at 1299.

53. Gregory, *supra* note 34, at 2018.

54. *Id.*

55. See, e.g., Toxic Substances Control Act § 2(a), 15 U.S.C. § 2601(a) (stating that humans and the environment are exposed to “a large number” of chemicals, some of which “may present an unreasonable risk of injury to health or the environment”).

of much research due to its possible effects on humans.⁵⁶ EDCs are believed to block endogenous steroid hormones from binding to receptors and hormone transport proteins, or by altering the metabolism or synthesis of endogenous hormones and thereby disrupting an organism's endocrine system.⁵⁷ EDCs may alter gene expression in cells, which is "of particular concern for the developing organism, as it is sensitive to changes in the hormonal milieu, or drug or chemical exposure, which can result in changes that are permanent."⁵⁸ Studies suggest EDCs contribute to the development of cancer, reduce human sperm counts, cause temporal increases in the frequency of developmental abnormalities of the male reproductive tract, and premature onset of puberty in human females.⁵⁹

Two EDCs, phthalates and bisphenol A ("BPA"), are relevant to this article due to their use in plastic manufacturing.⁶⁰ Plastics are typically manufactured by mixing additives with the plastic resins.⁶¹ Phthalates are added as "plasticizers," which aid in making plastic products malleable,⁶² and are found in soft plastic products, gel capsules, cosmetics, and other personal-care products.⁶³ Phthalates are known to leach out of products, and American and European studies have identified high levels of monoester metabolites of phthalates in the urine of the general public.⁶⁴ In animal studies, phthalates have been linked to "cryptorchidism, hypospadias, atrophy or agenesis of sex accessory organs, testicular lesions (e.g. small fluid-filled testes), reduced daily sperm production, delayed preputial separation, permanent retention of nipples, and decreased (feminized) anogenital distance".⁶⁵

56. See Holger M. Koch & Antonia M. Calafat, *Human Body Burdens of Chemicals Used in Plastic Manufacture*, 364 PHIL. TRANSACTIONS ROYAL SOC'Y B. 2063, 2063-64 (2009).

57. Chris E. Talsness et al., *Components of Plastic: Experimental Studies in Animals and Relevance for Human Health*, 364 PHIL. TRANSACTIONS ROYAL SOC'Y B. 2079, 2079 (2009).

58. *Id.*

59. *Id.* at 2080.

60. Koch & Calafat, *supra* note 56, at 2064.

61. Andrady & Neal, *supra* note 20, at 1979.

62. *Id.*

63. Talsness et al., *supra* note 57, at 2080.

64. *Id.* at 2080, 2083 (noting that the U.S. Centers for Disease Control and Prevention has reported that 93% of Americans tested had detectable levels of BPA in their urine, and that other studies have identified "virtually identical" levels in blood or pregnant women and their fetuses).

65. *Id.* at 2081.

Similarly, BPA is extensively used in the manufacturing of epoxy resins, polycarbonate plastics and brominated flame retardants, and is found in food and beverage packaging⁶⁶ throughout the world, including sport drink bottles, water bottles, and baby bottles.⁶⁷ Many BPA products are manufactured to be reusable and are marketed as microwaveable, although reuse and heating are both known to increase leaching of BPA into the food or beverage contained within the packaging.⁶⁸ Animal studies concerning the effects of BPA are particularly concerning, as adverse effects are reported in response to exposures that produce blood levels in animals below those reported in humans.⁶⁹ Among the adverse effects reported are correlatives to disease trends in humans.⁷⁰ For example, exposure to BPA during the development stages has been found to increase body weight later in life.⁷¹ This may help explain epidemical obesity in those regions of the world where these plastics are common.⁷² Animals exposed to BSA at human exposure levels have also developed prostate hyperplasia and cancer, mammary hyperplasia and cancer, abnormal urethra development and obstruction, reduced sperm counts, premature puberty in females, ovarian cysts and uterine fibroids, abnormal oocyte chromosomes, insulin resistance, and hyperactivity—which all correspond to trends in human health.⁷³ In light of these studies, the U.S. Environmental Protection Agency (“EPA”) recently announced actions to scrutinize the environmental effects of BPA, including “requiring manufacturers to provide test data to assist the agency in evaluating its possible impacts, including long-term effects on growth, reproduction, and development in aquatic organisms and wildlife.”⁷⁴

Unfortunately, the chemicals manufactured into plastic are not the only threats to human health; as noted above,⁷⁵ chemicals that have been released into the general environment also pose a

66. *Id.* at 2080.

67. *Id.* at 2082.

68. *Id.*

69. *Id.* at 2085.

70. *Id.*

71. *Id.*

72. *See Id.*

73. *Id.* at 2085 tbl.1.

74. *EPA to Scrutinize Environmental Impact of Bisphenol A*, ENVTL. PROT. (Apr. 5, 2010), <http://eponline.com/articles/2010/04/05/epa-to-scrutinize-environmental-impact-of-bisphenol-a.aspx>.

75. *See infra* text accompanying notes 76–84.

significant risk, particularly when combined with plastics. Many hydrophobic anthropogenic contaminants (“HACs”), such as polychlorinated biphenyls (“PCBs”) and dichlorodiphenyl-trichloro-ethane (“DDT”) and its metabolites, are well known for their effect on human health.⁷⁶ These hydrophobic contaminants are found in sediments, seawater, and marine biota the world over, with high concentrations found near the U.S., Western Europe, and Japan.⁷⁷

These HACs float on the top of our seas and adsorb into plastic⁷⁸ due to plastic’s lipophilic properties.⁷⁹ “Small bits of plastic concentrate persistent organic pollutants up to a million times their levels in the surrounding sea water.”⁸⁰ For example, particularly high levels of PCBs are found in beached plastic in Los Angeles and San Francisco, California.⁸¹ As marine invertebrates, vertebrates and birds eat plastic, or feed on smaller animals that have ingested plastic, they are also feeding on EDCs and HACs. Through the process of digestion, the contaminants contained in plastics can be transferred to the tissue of the consuming animal.⁸² As one looks up the food chain, these contaminants are increased due to biomagnification: tissue concentrations of EDCs and HACs are amplified through the food web.⁸³ “You can buy certified-organic produce, but no fishmonger on earth can sell you a certified-organic, wild-caught fish.”⁸⁴ The end result is that humans, too, are ingesting and concentrating these chemicals, to potentially disastrous effect.

76. See, e.g., 15 U.S.C. § 2605(e) (designating PCBs a “hazardous chemical substance”); see also *Envl. Def. Fund, Inc. v. EPA*, 489 F.2d 1247, 1254 (D.C. Cir. 1973) (finding “substantial evidence” in the record to support the EPA Administrator’s ban on DDT).

77. Emma L. Teuten et al., *Transport and Release of Chemicals from Plastics to the Environment and to Wildlife*, 364 PHIL. TRANSACTIONS ROYAL SOC’Y B. 2027, 2035 (2009).

78. See generally *id.* at 2027–37.

79. *Late Night with David Letterman: Captain Charles Moore* (CBS television broadcast Mar. 15, 2010), available at http://www.cbs.com/late_night/late_show/video/?pid=i6iyTCx7bqL_M5zNbvF5YPA7ZQY0NCW0&nrd=1.

80. *Captain Charles Moore on the Seas of Plastic*, TED (Feb. 2009), http://www.ted.com/talks/lang/eng/capt_charles_moore_on_the_seas_of_plastic.html [*hereinafter* TED Talks Video]; see also Nat’l Oceanic & Atmospheric Admin., *supra* note 7 (stating that “[p]lastic debris attracts and accumulates hydrophobic organic toxins such as PCBs (polychlorinated biphenyls) up to 100,000–1,000,000 times ambient seawater concentrations.”).

81. Teuten et al., *supra* note 77, at 2036 fig.7.

82. *Id.* at 2040.

83. *Id.*

84. TED Talks Video, *supra* note 80.

There are also important economic considerations to consider, including repair and replacement costs for ships damaged by ocean-bound plastic and clean-up costs for plastic that is washed ashore. A survey conducted in Newport, Oregon showed that 58% of fishermen had incurred damage to their vessels due to plastic debris, resulting in an average expense of \$2,725 per vessel.⁸⁵ Further, according to the United Nations Environment Programme (“UNEP”), an estimated \$50 million has been awarded by insurance companies for repairs from damage incurred by marine litter.⁸⁶ Regarding clean-up costs, in 1999, garbage was collected each week from a six-mile stretch of beach, by and within Orange County, California, at a cost to taxpayers of \$350,000.⁸⁷ So long as plastic finds its way to the ocean, these costs will continue to be a reality for those who own commercial and personal craft, and for communities that use and care for the 12,383 miles of national coastline.⁸⁸

2. The Papahānaumokuākea Marine National Monument

Created by Presidential proclamation in 2006,⁸⁹ the Papahānaumokuākea Marine National Monument (“Monument”) is one of the largest marine conservation areas in the world.⁹⁰ The Monument consists of nearly 1,200 nautical miles of coral islands, seamounts, banks and shoals, and is home to more than 7,000 marine species, nearly half of which are unique to the Hawaiian Islands.⁹¹ President George W. Bush’s authority for creating the Monument was derived from the Antiquities Act of 1906.⁹² This authority provides several benefits and presents sev-

85. U.N. Env’t Programme Reg’l Seas Coordinating Office, *UNEP Regional Seas Programme, Marine Litter and Abandoned Fishing Gear*, at 8 (Apr. 2005), available at http://www.unep.org/regionalseas/marinelitter/publications/docs/RS_DOALOS.pdf.

86. *Id.*

87. *Id.* at 7.

88. NAT’L OCEANIC & ATMOSPHERIC ADMIN., NOAA/PA 71046, *THE COASTLINE OF THE UNITED STATES (1975)*, available at http://shoreline.noaa.gov/_pdf/Coastline_of_the_US_1975.pdf.

89. Establishment of the Northwestern Hawaiian Islands Marine National Monument, Proclamation No. 8031, 71 Fed. Reg. 36,443 (June 15, 2006). See Appendix A for a map of the Monument.

90. *About Us*, PAPAHAŪAUMOKUĀKEA MARINE NAT’L MONUMENT, <http://papa-hanaumokuakea.gov/about/welcome.html> (last modified Jul. 28, 2010).

91. Proclamation No. 8031, 71 Fed. Reg. at 36,443.

92. 16 U.S.C. §§ 431-433.

eral challenges for management, enforcement and protection of the Monument.⁹³

The Monument is located within the Pacific Ocean, within the southern-most portion of the STCZ.⁹⁴ More than 52 metric tons of marine debris accumulates on the shores of the Monument's islands each year,⁹⁵ endangering the many species making the Monument home. One particular example is the Laysan albatross. Albatross nest in these islands, and the parents forage hundreds of miles over the GPGP in search of food for their young.⁹⁶ The parents mistake plastic flotsam such as bottle caps and cigarette lighters as food that they swallow and then regurgitate for the chicks.⁹⁷ To illustrate this point, in a study in 1965, 74% of the Laysan albatross chicks found dead had plastics in

93. See generally Sproat & Goss, *supra* note 4. There is a question as to whether the Antiquities Act can be enforced beyond 12 miles from U.S. shores. *Id.* at 58. Monuments created pursuant to the Antiquities Act are limited to "lands owned or controlled by the Government of the United States." 16 U.S.C. § 431. Under international law, territorial seas are limited to within 12 nautical miles of a state's shoreline. United Nations Convention on the Law of the Sea Part II, § 2, art. 3, Dec. 10, 1982, 1144 U.N.T.S. 397, available at http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm [hereinafter UNCLOS]; see also Territorial Sea of the United States of America, Proclamation No. 5928, 54 Fed. Reg. 1,977 (Dec. 27, 1988) (claiming a territorial sea on behalf of the U.S.). Contiguous zones can extend this an additional 12 nautical miles to prevent "infringement of [a state's] . . . sanitary laws and regulations." UNCLOS, *supra*, at Part II, § 4, art. 33(1)(a); see also Contiguous Zone of the United States, Proclamation No. 7219, 64 Fed. Reg. 48,701 (Aug. 2, 1999) (claiming a contiguous zone on behalf of the U.S.). Additionally, an exclusive economic zone ("EEZ") can extend up to 200 miles from the shoreline "for the purposes of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil . . .," with jurisdiction provided for "marine scientific research; [and] the protection and preservation of the marine environment." UNCLOS, *infra*, at Part V, art. 56(1); see also Exclusive Economic Zone of the United States, Proclamation No. 5030, 48 Fed. Reg. 10,605 (Mar. 10, 1983) (claiming an EEZ of 200 miles on behalf of the U.S.). "If th[e] lessor] limitation applies to Papahānaumokuākea, the outer 38 nautical miles of the monument are without enforceable protection" under U.S. law. Sproat & Goss, *supra* note 4, at 58. For a discussion on the U.N. Convention on the Law of the Sea, see *infra*, text accompanying notes 156–59.

94. Nat'l Oceanic & Atmospheric Admin., *supra* note 7.

95. *Id.* Under certain conditions, such as an El Niño event, the STCZ dips southward, depositing higher volumes of debris on the islands of the Monument than in years when these conditions are not present. NAT'L OCEANIC & ATMOSPHERIC ADMIN. ET AL., VOL. 1, PAPAĀHANAUMOKUĀKEA MARINE NATIONAL MONUMENT MANAGEMENT PLAN 194 (Dec. 2008), available at http://papahānaumokuākea.gov/management/mp/vol1_mmp08.pdf.

96. TED Talks Video, *supra* note 80.

97. *Id.*

their stomachs.⁹⁸ In a 1994-95 study of dead and injured Laysan albatross chicks, approximately 98% contained plastics in their systems.⁹⁹

It is reasonable to ask if the plastic may be cleaned up; unfortunately, this is not a viable solution. Contrary to images conjured-up as a result of hearing or reading the phrase "Great Pacific Garbage Patch," the GPGP is not a contiguous mass of floating debris;¹⁰⁰ as stated above, the plastic breaks down to its individual polymer molecules, resulting in a varied distribution of small fragments of debris.¹⁰¹ To simply vacuum up the plastic is not a feasible option.¹⁰² The GPGP is larger than a continent, and much of the plastic remains buoyant from just below the ocean's surface to 30 meters below.¹⁰³ Additionally, there would be no means for distinguishing the plastic from the "untold numbers of organisms that would be destroyed in the process,"¹⁰⁴ due to the small scale of the individual plastic pellets and the intermingling of plastic and organisms.

B. *Current International Water Quality Conventions and National Ocean Water Quality Statutes*

Recognition of pollution in the oceans is not a new phenomenon, nor are the attempts to prevent it. However, the sources, and types and methods of solutions to combat pollution have varied over the last 40 years. Among the agreements relevant to this article are the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 1972¹⁰⁵ ("London Convention") and its 1996 Protocol¹⁰⁶ ("London Protocol"), the International Convention for the Prevention of Pol-

98. Ryan et al., *supra* note 24, at 2007.

99. Heidi J. Auman et al., *Plastic Ingestion by Laysan Albatross Chicks on Sand Island, Midway Atoll, in 1994 and 1995* in ALBATROSS BIOLOGY AND CONSERVATION 239, 243 (Graham Robertson & Rosemary Gales eds. 1998), available at <http://www.usask.ca/toxicology/jgiesy/pdf/publications/BC-060.pdf>.

100. Nat'l Oceanic & Atmospheric Admin., *supra* note 7.

101. See *supra* text accompanying notes 24-25.

102. See MOORE, *supra* note 2, at 3.

103. *Id.* at 1, 3.

104. *Id.* at 3.

105. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, 26 U.S.T. 2403, 1046 U.N.T.S. 120 [hereinafter London Convention].

106. Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov. 8, 1996, 36 I.L.M. 1 [hereinafter London Protocol].

lution from Ships of 1973¹⁰⁷ (“MARPOL 73”) as amended by the Protocol of 1978¹⁰⁸ (“MARPOL 78”), and the United Nations Convention of the Law of the Sea¹⁰⁹ (“Law of the Sea”). The United States has also passed laws—in some cases under obligation of membership in the aforementioned international agreements—to prevent and remedy ocean pollution. This includes the Marine Protection, Research, and Sanctuaries Act of 1972¹¹⁰ (“MPRSA”), the Act to Prevent Pollution from Ships¹¹¹ (“APPS”), and the Marine Debris Research, Prevention, and Reduction Act of 2006¹¹² (“MDRPRA”). Due to the current batch of international and domestic laws relating to marine pollution prevention, it may appear as though sufficient measures are in place to prevent and reduce the presence of plastic debris in the oceans. This, however, is not the case. An explanation of each of these laws’ history, strengths and weaknesses follows.

The London Convention “was designed to provide the basic framework for global control of the deliberate disposal of all wastes in the ocean.”¹¹³ Specifically, the London Convention prevents nations from depositing wastes at sea that have been generated on land¹¹⁴ by prohibiting “any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea.”¹¹⁵ The prohibition is accomplished through the use of a permitting system, whereby a signatory state requires a permit for loading within its territory,¹¹⁶ or for the dumping of waste by ships under its flag at high sea.¹¹⁷ However, “the implication is that the [London] Convention does not apply to the dumping of wastes through ocean outfalls in in-

107. International Convention for the Prevention of Pollution from Ships, Nov. 2, 1973, 1340 U.N.T.S. 184.

108. Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973, Feb. 17, 1978, 1340 U.N.T.S. 61 [hereinafter MARPOL 78].

109. United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1183 U.N.T.S. 397 [hereinafter Law of the Sea].

110. Pub. L. No. 92-532, 86 Stat. 1052, 1061 (1972).

111. 33 U.S.C. §§ 1901-1915.

112. 33 U.S.C. §§ 1951-1958.

113. John Charles Kunich, *Losing Nemo: The Mass Extinction Now Threatening the World's Ocean Hotspots*, 30 COLUM. J. ENVTL. L. 1, 78 (2005).

114. *Id.*

115. London Convention, *supra* note 105, art. 3, § 1(a)(i).

116. *Id.* at art. VI, § 2(a).

117. *Id.* at art. VI, § 2(b).

ternal waters of a State.”¹¹⁸ This is due to Article 3, section 3, which defines “sea” in part as “all marine waters other than the internal waters of States.”¹¹⁹ Thus, while the London Convention created “a formidable international legal firewall between clean seas and irresponsible dumping practices,”¹²⁰ it only addresses sea-based dumping, as opposed to land-based sources of pollution. The London Convention is implemented in the U.S. by the Marine Protection, Research, and Sanctuaries Act of 1972 (“MPRSA”), as amended by the Ocean Dumping Ban Act of 1988.¹²¹ The London Convention was modified by the 1996 Protocol to the London Convention.¹²²

The MPRSA has three purposes: (1) to regulate intentional dumping at sea, (2) to research the causes and sources of oceanic dumping, and (3) to establish marine sanctuaries. Under Title I of MPRSA (“Ocean Dumping Act”), all ocean dumping is prohibited in the U.S. Territorial Sea or Contiguous Zone by any U.S. vessel or by any vessel sailing from a U.S. port, except for those wastes allowed by permit.¹²³ This ocean dumping permit program is overseen by the EPA and the U.S. Corps of Engineers (“Corps”).¹²⁴ Specifically banned materials include radiological, chemical and biological warfare agents and any high-level radioactive waste, and medical wastes.¹²⁵ Prior to the Ocean Dumping Ban Act, sewage sludge and industrial waste were permitted for ocean dumping by the EPA, but these materials have been

118. Daud Hassan, *International Conventions Relating to Land-Based Sources of Marine Pollution Control: Applications and Shortcomings*, 16 GEO. INT'L ENV'T'L L. REV. 657, 664 (2004).

119. London Convention, *supra* note 105, art. 3, § 3.

120. Sielen, *supra* note 32.

121. Pub. L. No. 92-532, 86 Stat. 1052, 1061, *amended by* Pub. L. No. 100-688, 102 Stat. 4153 (Titles I and II are codified at 33 U.S.C. §§ 1401-1445, and Title III is codified at 16 U.S.C. §§ 1431-45).

122. London Protocol, *supra* note 106, at 7. Membership is optional for signatories to the London Convention and it should be noted that, although it has signed the London Protocol, the United States has refrained from ratifying it at this time. *London Convention*, ENVTL. PROT. AGENCY, http://water.epa.gov/type/oceb/ocean_dumping/dredgedmaterial/londonconvention.cfm (last updated Aug. 26, 2011).

123. 33 U.S.C. § 1411. Permits for materials are determined by the procedures and criteria of 40 C.F.R. Supchapter H. *See supra* note 91 (discussing territorial seas, contiguous zones, and exclusive economic zones).

124. *See* 33 U.S.C. §§ 1412(a), 1413(a). The U.S. Corps of Engineers issues permits for dredged material, while the EPA issues permits for all other allowed material. *Id.*

125. 33 U.S.C. § 1412(a).

completely prohibited since December 31, 1991.¹²⁶ “Virtually all [permitted] ocean dumping that occurs today [within U.S. jurisdiction] is dredged material, sediments removed from the bottom of waterbodies in order to maintain navigation channels,” pursuant to permits issued by the Corps.¹²⁷ Thus, any plastic that may be dumped by vessels in U.S. waters is an unpermitted dumping. However, the fact that it is unpermitted is more a result of the act of dumping, rather than the substance being dumped.

Title II of MPRSA mandates research into the “possible long-range effects of pollution, overfishing, and man-induced changes of ocean ecosystems,”¹²⁸ and more generally, “ocean dumping and other methods of waste disposal.”¹²⁹ These research programs are handled by the National Oceanic and Atmospheric Administration (“NOAA”) and the EPA. NOAA is responsible for “a comprehensive and continuing program of research with respect to the possible long-range effects of pollution, overfishing, and man-induced changes of ocean ecosystems.”¹³⁰ Conversely, the EPA is responsible for conducting research into ending or minimizing the dumping of “material which may unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities, and [] developing disposal methods as alternatives to the dumping described [above]”¹³¹

Title III provides for the establishment of marine sanctuaries for “areas of the marine environment [that] possess conservation, recreational, ecological, historical, scientific, educational, cultural, archeological, or esthetic qualities which give them special national, and in some cases international, significance.”¹³² Areas so identified are afforded protection and management “to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes.”¹³³

126. *Id.* § 1414b(a)(1)(B). Dumping of these materials is allowed in emergency situations, where no other viable alternative is available. *Id.* § 1412a(a).

127. CLAUDIA COPELAND, CONG. RESEARCH SERV., RS 20028, OCEAN DUMPING ACT: A SUMMARY OF THE LAW 3 (1999)

128. 33 U.S.C. § 1442.

129. *Id.* § 1443.

130. *Id.* § 1442(a)(1).

131. *Id.* § 1443(a)(1)(A).

132. 16 U.S.C. § 1431(a)(2).

133. *Id.* § 1431(b)(3).

MARPOL 73 was a result of an international convention organized by the United Kingdom in 1954 and was originally conceived to combat oil pollution of the seas.¹³⁴ While oil pollution was recognized to be a significant threat to the marine environment, other forms of pollution were still recognized as worthy of preventing. In 1973, an international conference adopted MARPOL 73, by largely incorporating the 1954 Oil Convention. Nonetheless, it additionally addressed chemicals, harmful substances carried in packaged form, sewage, and garbage.¹³⁵ In spite of the adoption of MARPOL 73, it failed to receive ratification by a sufficient number of states to enter into force.¹³⁶ In 1978, another conference was held, at which the MARPOL 78 Protocol was adopted.¹³⁷ Included within the MARPOL 78 Protocol was an amendment to terms of MARPOL 73 sufficient to entice ratification.¹³⁸ Because MARPOL 73 remained void of authority, the MARPOL 78 Protocol absorbed MARPOL 73, and the final agreement, the International Convention for the Prevention of Marine Pollution from Ships of 1973, as modified by the Protocol of 1978, relating thereto ("MARPOL 73/78"), entered into force on October 2, 1983.¹³⁹ MARPOL 73/78 is "the most important global treaty for the prevention of pollution from the operation of ships; it governs the design and equipment of ships; establishes system of certificates and inspections; requires states to provide reception facilities for the disposal of oily waste and chemicals."¹⁴⁰ The United States signed MARPOL 73/78, for Annexes I and II, on February 17, 1978.¹⁴¹ MARPOL 73/78

134. INT'L MARITIME ORG., FOCUS ON IMO: MARPOL - 25 YEARS at 3 (October 1998) [*hereinafter* MARPOL 73/78], available at [http://www.imo.org/KnowledgeCentre/ReferencesAndArchives/FocusOnIMO\(Archives\)/Documents/Focus%20on%20IMO%20-%20MARPOL%20-%2025%20years.pdf](http://www.imo.org/KnowledgeCentre/ReferencesAndArchives/FocusOnIMO(Archives)/Documents/Focus%20on%20IMO%20-%20MARPOL%20-%2025%20years.pdf). This Convention was the International Convention for the Prevention of Pollution of the Sea by Oil of 1954. *Id.*

135. *Id.* at 5.

136. *Id.* at 6.

137. *Id.* at 2.

138. *Id.* These changes included "allow[ing] States to become Party to the Convention by first implementing Annex I [], as it was decided that Annex II [] would not become binding until three years after the Protocol entered into force." *Id.*

139. *Id.* at 2, 7. Only Annexes I, Regulations for the Prevention of Pollution by Oil, and II, Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (Chemicals), went into effect on this date. Annexes III, IV, V, and VI were effectuated at later dates. *Id.* For purposes of this article, only Annex V will be discussed.

140. MARPOL: Summary, INT'L MARITIME ORG., http://www.imo.org/dynamic/mainframe.asp?topic_id=1514&doc_id=7603#Summary (last updated Feb. 24, 2006).

141. See MARPOL 78, *supra* note 108.

is implemented in the U.S. by the Act to Prevent Pollution from Ships, as amended by the Marine Plastic Pollution Research and Control Act (“Plastic Pollution Act”).¹⁴²

MARPOL 73/78, Annex V, Prevention of Pollution by Garbage from Ships, is the most important portion of the Convention when considering international approaches to combating plastic as an ocean pollutant. Annex V “deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. . . . but perhaps the most important feature of the Annex is the complete ban imposed on the dumping into the sea of all forms of plastic.”¹⁴³

The Plastic Pollution Act formally implements MARPOL Annex V within the United States.¹⁴⁴ Any ship “that is of United States registry or nationality, or one operated under the authority of the United States . . . and [any other] ship . . . , while in the navigable waters or the Exclusive Economic Zone of the United States”¹⁴⁵ is prohibited from “discharg[ing] into the sea, or into the navigable waters of the United States, plastic or garbage mixed with plastic, including, but not limited to, synthetic ropes, synthetic fishing nets, and plastic garbage bags. All garbage containing plastics requiring disposal must be discharged ashore or incinerated.”¹⁴⁶ Significantly, this makes the dumping of plastic, as a substance, illegal within U.S. jurisdiction, rather than the mere dumping, as is the case with the Ocean Dumping Act.

In spite of the intent of MARPOL 73/78, determining which nation has jurisdiction to investigate and prosecute pollution violations has been a major difficulty in its implementation.¹⁴⁷ This is because among the three potential parties—the Flag State, under whose flag the ship in question is registered; the Port State, the State in which the ship in question has made a port-of-call; and the Coastal State, in whose territorial waters the ship may be passing—any combination may have jurisdiction.¹⁴⁸

142. 33 U.S.C. §§ 1901-1915, amended by 33 U.S.C. §§ 1901-1915.

143. *International Convention for the Prevention of Pollution from Ships (MARPOL)*, INT’L MARITIME ORG., <http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-%28marpol%29.aspx> (last visited Aug. 10, 2011).

144. 33 U.S.C. § 1901(a)(5). The specific requirements of Annex V are implemented for the U.S. through 33 C.F.R. Part 151.

145. 33 C.F.R. § 151.51(a).

146. 33 C.F.R. § 151.67.

147. Rebecca Becker, *MARPOL 73/78: An Overview in International Environmental Enforcement*, 10 GEO. INT’L ENV’T L. REV. 625, 631 (1998).

148. *Id.*

Enforcement is further hindered by disparity among nations' ability and willingness to enforce the requirements of MARPOL 73/78.¹⁴⁹ In spite of, or perhaps because of, overlapping jurisdiction, most countries report violations to the flag state.¹⁵⁰ This is because the country that prosecutes a case under MARPOL is responsible for the resulting legal expenses.¹⁵¹ Between 1983 and 1990, 1,335 violations were reported by port states; in only 238 of these instances did the port state prosecute, as opposed to simply report the violation to the flag state.¹⁵² Of those so reported, only 77 resulted in fines, while eight resulted in warnings, and ten in unspecified actions.¹⁵³

The United States Coast Guard conducted a study of compliance with the Plastic Pollution Act in 1994, which found that, "[d]espite implementation of . . . Annex V regulations to date, large quantities of plastic continue to wash ashore, obstruct navigation, and entangle marine life. Very likely, much of this plastic was illegally discharged as garbage from ships."¹⁵⁴ The compliance study went on to state that less than 20% of vessels calling at ports off-load garbage at a reception facility, yet there is no sign of garbage or separated plastics on these same ships when searched.¹⁵⁵ "The evidence strongly suggests that, despite current regulations, large amounts of garbage are still being discharged overboard before plastics are separated out for later disposal ashore or incineration aboard."¹⁵⁶ Because many nations lack the prosecutorial means or intent, these unpermitted discharges go essentially unpunished.

Finally, there is the Law of the Sea, which contains an article relating specifically to land-based sources of marine pollution. Specifically, Article 207 states:

States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources, including rivers, estuaries, pipelines and outfall structures, taking

149. *Id.* at 633.

150. Ryan P. Lessman, *Current Protections on the Galapagos Islands are Inadequate: The International Maritime Organization Should Declare the Islands a Particularly Sensitive Sea Area*, 15 *COLO. J. INT'L ENV'T'L L. & POL'Y* 117, 145 (2004).

151. *Id.*

152. Becker, *supra* note 147, at 632.

153. *Id.* at 633

154. Recordkeeping of Refuse Discharges from Ships, 59 Fed. Reg. 18,700 (Apr. 19, 1994) (to be codified at 33 C.F.R. pt. 151)

155. *Id.*

156. *Id.*

into account internationally agreed rules, standards and recommended practices and procedures. . . .

States shall take other measures as may be necessary to prevent, reduce and control such pollution. . . .

Laws, regulations, measures, rules, standards and recommended practices and procedures referred to in paragraphs 1, 2 and 4 shall include those designed to minimize, to the fullest extent possible, the release of toxic, harmful or noxious substances, especially those which are persistent, into the marine environment.¹⁵⁷

Although the Law of the Sea has not been ratified by the United States, the Executive Branch has sought ratification, and the U.S. considers “most of its provisions to reflect binding customary international law.”¹⁵⁸

One particularly significant program that results from the cross-section of the above international laws includes the identification and designation of Particularly Sensitive Sea Areas (“PSSAs”). The Law of the Sea identifies categories of areas that may require greater environmental protection, due to rare or fragile ecosystems.¹⁵⁹ Specifically, Article 211(6)(a) provides that

Where the [general] international rules and standards . . . are inadequate to meet special circumstances and coastal States have reasonable grounds for believing that a particular, clearly defined area of their respective exclusive economic zones is an area where the adoption of special mandatory measures for the prevention of pollution from vessels is required for recognized technical reasons in relation to its oceanographical and ecological conditions, as well as its utilization or the protection of its resources and the particular character of its traffic, the coastal States, after appropriate consultations through the competent international organization with any other States concerned, may, for that area, direct a communication

157. Law of the Sea, *supra* note 109, Part XII, § 5, art. 207(1), (2), (5).

158. COMM. ON THE EFFECTIVENESS OF INT’L AND NAT’L MEASURES TO PREVENT AND REDUCE MAR. DEBRIS AND ITS IMPACTS, NAT’L RESEARCH COUN’L OF THE NAT’L ACADEMIES, *TACKLING MARINE DEBRIS IN THE 21ST CENTURY* 50 (2009) [hereinafter *TACKLING MARINE DEBRIS*]; *see, e.g.*, Memorandum: National Policy for the Oceans, Our Coasts, and the Great Lakes, 74 Fed. Reg. 28,591 (June 12, 2009) (referring to “customary international law as reflected in the 1982 United Nations Convention on the Law of the Sea.”).

159. AUSTL. MARITIME SAFETY AUTH., *PARTICULARLY SENSITIVE SEA AREAS FACT SHEET 1* (June 2008), *available at* http://www.amsa.gov.au/publications/fact_sheets/psa_fact.pdf.

to that organization, submitting scientific and technical evidence in support and information on necessary reception facilities.¹⁶⁰

Based on this authority, the International Maritime Organization ("IMO") established the Marine Environmental Protection Committee ("MEPC"), to which IMO member governments may submit PSSA applications.¹⁶¹ Those PSSAs must have an approved associated protective measure ("APM"), which provides for the prevention, reduction, or elimination of the threat or identified vulnerability associated with the area.¹⁶² PSSA designation obligates all IMO member governments to ensure ships flying their flag comply with the APMs for that area.¹⁶³ The Monument is among the eleven currently designated PSSAs.¹⁶⁴

The MDRPRA may be viewed as "another example of the dissatisfaction of some in the environmental and coastal communities with the effectiveness of MARPOL [73/78] Annex V."¹⁶⁵ The legislation was enacted "to help identify, determine sources of, assess, reduce, and prevent marine debris and its adverse impacts . . ."; reactivate the Interagency Marine Debris Coordinating Committee ("IMDCC"); and "to develop a Federal marine debris information clearinghouse."¹⁶⁶

Many parties have responsibility under the presently existing body of marine pollution law. Chief among these responsibilities, of course, are the prevention of dumping of plastic, in addition to other debris, in marine environments. Flag states continue to need to permit ships within their jurisdiction; port states continue to need to provide receptacles for waste generated while at sea; and coastal states continue to need to inspect ships as they travel through the territorial sea of the state at issue. In general, each party state to the London Convention, London Protocol, U.N. Law of the Sea, and MARPOL 73/78 will have to comply with continued enforcement of these respective agreements.

160. Law of the Sea, *supra* note 109, Part XII, art. 211(6)(a). The "competent international organization" is "universally understood to be IMO." AUSTL. MARITIME SAFETY AUTH., *supra* note 159.

161. AUSTL. MARITIME SAFETY AUTH., *supra* note 159.

162. *Id.*

163. *Id.* at 2.

164. *Id.*

165. Constantine G. Papavizas & Lawrence I. Kiern, 2005-2006 U.S. Maritime Legislative Developments, 38 J. MAR. L. & COM. 267, 289 (2007).

166. 33 U.S.C. § 1951. The IMDCC was originally created by the Plastic Pollution Act; however, it suffered from a lack of priority and funding. TACKLING MARINE DEBRIS, *supra* note 158, at 75.

Pursuant to the PSSA status of the Monument, IMO member governments are required to comply with the specific AMPs associated with the Monument.¹⁶⁷ Among the AMPs include a ship reporting system, required for “all ships 300 gross tonnage or greater, and all ships in the event of a developing emergency, and that are in transit through the reporting area,” which is to include such information as ship identification data, destination, general categories of hazardous cargo on board, relevant defects or deficiencies, and the ship type and size.¹⁶⁸ In the event a ship fails to report, the U.S. will utilize “appropriate action . . . including interaction with the flag State—in accordance with customary international law as reflected in the 1982 United Nations Convention of the Law of the Sea.”¹⁶⁹

As demonstrated above, there is not one, but three separate and distinct international agreements currently in force relating to dumping in oceans. Pursuant to membership in or compliance with these agreements, the U.S. has passed multiple laws to complement and implement these agreements. Yet, for all of these, plastics continue to reach our oceans, only to be consolidated within the trash-collecting gyres, including the GPGP. This occurs because the focus of each law is on dumping at sea, even though land-based “[n]onpoint source pollution and runoff during storms are the most significant sources of pollutants, including debris, that are washed into coastal and marine waters.”¹⁷⁰ To truly combat plastic marine debris, a number of measures are necessary.¹⁷¹

167. See generally 3 PAPAHAUUMOKUAKEA MARINE NAT'L MONUMENT, PAPAHAUUMOKUAKEA MARINE NATIONAL MONUMENT: MONUMENT MGMT. PLAN app. G, available at <http://www.fws.gov/midway/volume%20iii%20app%20g.pdf> (last visited May 5, 2010).

168. *Id.* at G-24–25.

169. *Id.* at G-28.

170. TACKLING MARINE DEBRIS, *supra* note 158, at 69.

171. Many necessary measures are beyond the scope of this article. Among these may be reductions in plastic in the market place; the increased research, development, and use of plastics sourced from organic substances, and other biodegradable plastics; bans on specific plastic resins, additives, or products; taxes on specific types of plastic; economic incentives, such as return deposits; and changes in consumer behavior.

III.

PROPOSAL: INTERNATIONAL OCEANIC DEBRIS
PREVENTION AND REDUCTION AGREEMENT

Because most marine debris originates on land, it is imperative to prevent such debris from reaching the ocean. In the United States, two significant laws are already in place: the Clean Water Act¹⁷² (“CWA”) and the Resource Conservation and Recovery Act¹⁷³ (“RCRA”). Neither specifically addresses marine debris, but each includes standards applicable to the control of land-based sources of marine debris.¹⁷⁴ With reasonable amendment, much debris may be prevented from reaching international waters. However, international adoption of these stricter standards will be necessary to achieve any significant progress.

The CWA protects our national waters via a dual-pronged approach: first, by requiring would-be polluters to apply for a permit via the National Pollutant Discharge Elimination System (“NPDES”);¹⁷⁵ and second by implementing water quality standards (“WQS”) to protect those water bodies affected by nonpoint sources of pollution.¹⁷⁶ These dual methods can be better utilized to prevent plastic marine debris.

Improperly disposed-of trash can be washed into streams, combined sewer systems, and municipal separate storm sewer systems (“MS4s”) during precipitation events. Storm water runoff, a recognized source of marine debris along U.S. coasts and waterways, is regulated as a point source under the NPDES.¹⁷⁷ During high-rain events, combined sewer systems and MS4s can be overwhelmed to the point of causing water—carrying plastic trash—to escape the treatment plant; accordingly, combined sewer systems and MS4s are regulated as point sources under the NPDES.¹⁷⁸

All permitted facilities and systems of treatment and control must be properly operated and maintained by the permittee.¹⁷⁹

172. 33 U.S.C. §§ 1251-1387.

173. 42 U.S.C. §§ 6901-6992k.

174. INTERAGENCY MARINE DEBRIS COORDINATING COMM., INTERAGENCY REPORT ON MARINE DEBRIS SOURCES, IMPACTS, STRATEGIES & RECOMMENDATIONS 34 (Aug. 2008), available at <http://marinedebris.noaa.gov/about/pdfs/imdcreport.pdf>.

175. 33 U.S.C. § 1342.

176. *Id.* § 1313.

177. *Id.* § 1342(p).

178. *Id.* § 1342(p), (q).

179. 40 C.F.R. § 122.41(e).

However, a higher standard currently employed for non-point sources can be adopted into the requirements of NPDES permits. Specifically, “best management practices” (“BMPs”), which are defined to mean “schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of ‘waters of the United States,’” and “include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.”¹⁸⁰ Permitted municipal storm water facilities should be reviewed to ensure implementations of these management measures, such as use and maintenance of storm drains and BMPs like storm drain filters.¹⁸¹ Additionally, trash should be included as an effluent for permitting purposes, with permit modifications to incorporate the waste load allocations¹⁸² and to address monitoring and implementation for these point sources.

Utilizing the second prong of the CWA, adjustments should be made to the Total Maximum Daily Loads (“TMDLs”) for water bodies. TMDLs are “a calculation of the maximum amount of a pollutant that a body of water can receive and meet water quality standards, along with an allocation of that amount to the pollutant’s sources.”¹⁸³ Although TMDLs are set by states, territories, and tribes based on a list of impaired waters¹⁸⁴ and specific water quality criteria (“WQC”),¹⁸⁵ the EPA is required to recommend “pollutants suitable for maximum daily load measurements.”¹⁸⁶ Pursuant to this mandate, the EPA has identified and recommended 150 pollutants suitable for TMDL measurement, none of which are plastic,¹⁸⁷ based on

180. *Id.* § 122.2.

181. OFFICE OF RESPONSE & RESTORATION, NAT’L OCEANIC & ATMOSPHERIC ADMIN., HAWAII MARINE DEBRIS WORKSHOP SUMMARY REPORT D-12 (Feb. 20, 2008), available at <http://marinedebris.noaa.gov/projects/pdfs/himdapsummary.pdf>.

182. “Wasteload allocation” is defined as “[t]he portion of a receiving water’s loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation.” 40 C.F.R. § 130.2(h).

183. JAMES WOODLEY, ENVTL. PROT. AGENCY, ASSESSING AND MONITORING FLOATABLE DEBRIS § 5.4 (Aug. 2002), available at <http://www.epa.gov/owow/oceans/debris/floatingdebris/debris-final.pdf>.

184. See 33 U.S.C. § 1313.

185. 40 C.F.R. § 131.6(c).

186. 33 U.S.C. § 1314(a)(2).

187. See *National Recommended Water Quality Criteria*, ENVTL. PROT. AGENCY, <http://www.epa.gov/waterscience/criteria/wqctable/> (last visited Aug. 10, 2011).

factors necessary to restore and maintain the chemical, physical, and biological integrity of all navigable waters, ground waters, waters of the contiguous zone, and the oceans; [] the factors necessary for the protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving waters and to allow recreational activities in and on the water; and [] on the measurement and classification of water quality; and [] for the purpose of [water quality standards and implementation plans.]¹⁸⁸

Taking the factors listed above into consideration, the pollutants recommended should be expanded to include plastic. The incorporation of trash into the TMDL allocation for priority watersheds would provide resources to reduce this load.¹⁸⁹

Individual states have already begun to identify trash generally as a pollutant for WQS purposes, including plastic;¹⁹⁰ however this needs to be done on a national basis. The CWA already provides that, for waters within a state's jurisdiction that have not had WQSs established, the state "shall . . . estimate for such waters the total maximum daily load . . . for those pollutants which the [EPA] identifies under section 1314(a)(2) . . . as suitable for such calculation."¹⁹¹ Subject to the notice and comment rulemaking procedure set out in the Administrative Procedure Act,¹⁹² the EPA should add plastic debris as a recommended pollutant. At a minimum, this would result in every state estimating the TMDL for plastic in each body of water therein.

Of course, the plastic caught in these waterways is coming from somewhere, and "[l]andfills are a primary source of terrestrial debris."¹⁹³ Although non-hazardous solid waste is generally regulated by state and local governments,¹⁹⁴ Subtitle D of RCRA provides for the management of municipal and industrial solid waste,¹⁹⁵ and the EPA has promulgated some regulations per-

188. 33 U.S.C. § 1314(a)(2).

189. Nat'l OCEANIC & ATMOSPHERIC ADMIN., HAWAII DEBRIS ACTION PLAN 17, available at <http://marinedebris.noaa.gov/projects/pdfs/himdap.pdf>.

190. See WOODLEY, *supra* note 183.

191. 33 U.S.C. § 1313(d)(3).

192. See 5 U.S.C. § 553.

193. JANE HETHERINGTON ET AL., THE MARINE DEBRIS RESEARCH, PREVENTION AND REDUCTION ACT: A POLICY ANALYSIS 17 (2005), available at <http://www.columbia.edu/cu/mpaenvironment/pages/projects/sum2005/Marine%20Debris%20Final%20Report%20Sum2005.pdf>.

194. ENVTL. PROT. AGENCY, RCRA ORIENTATION MANUAL 2008 II-2 (2008), available at <http://www.epa.gov/wastes/inforesources/pubs/orientat/rom2.pdf>.

195. See 40 C.F.R. § 258.2; see generally 40 C.F.R. § 258.1 (federal criteria applicable to Municipal Solid Waste Landfills) & 40 C.F.R. pt. 257, subpt. A & B (2010) (federal criteria for nonhazardous industrial waste facilities and practices).

taining to how disposal facilities should be designed and operated.¹⁹⁶

Municipal solid waste landfills (“MSWLFs”) are defined as discrete areas of land or excavations that receive household waste, commercial solid waste, non-hazardous sludge, conditionally exempt small quantity generator waste, and industrial solid waste.¹⁹⁷ Among the major aspects of MSWLFs addressed by EPA regulations, operational regulations¹⁹⁸ of these facilities are of particular importance to this article. Operation regulations require MSWLF owners and operators to cover disposed waste with six inches of earthen material each day, or more frequently as necessary to control disease vectors, fires, odors, blowing litter, and scavenging;¹⁹⁹ alternative materials of alternative thickness may be used if approved.²⁰⁰ However, trash can be blown off of inadequately covered landfills and land directly into oceans.²⁰¹

Generally, MSWLFs may not cause discharges that would violate the NPDES or water quality management plan requirements under the CWA.²⁰² “Because landfills must not retain water, they are created with extensive drainage systems which collect water and channel it to ditches located at the base of the landfill.”²⁰³ MSWLFs must be able to divert water run-on to the equivalent of peak discharge from a 25-year storm, and to control run-off in such a way as to control a 24-hour period during a 25-year storm.²⁰⁴ Arkansas, for example, requires all landfills to control storm water run-off through the construction of sedimentation ponds, capable of meeting the federal 24-hour/25-year storm standard.²⁰⁵

196. ENVTL. PROT. AGENCY, *supra* note 194.; *see generally* 40 C.F.R. pt. 257, subpt. A.

197. 40 C.F.R. § 258.2.

198. *Id.* pt. 258, subpt. C.

199. *Id.* § 258.21(a).

200. *Id.* § 258.21(b).

201. HETHERINGTON ET AL., *supra* note 193.

202. 40 C.F.R. § 258.27.

203. HETHERINGTON ET AL., *supra* note 193.

204. 40 C.F.R. § 258.26(a).

205. ARK. DEP’T OF ENVTL. QUALITY, ARG160000, FACT SHEET AND SUPPLEMENTARY INFORMATION FOR GENERAL PERMIT DISCHARGES FROM SANITARY LANDFILLS LOCATED WITHIN THE STATE OF ARKANSAS 6, *available at* http://www.adeq.state.ar.us/water/branch_permits/individual_permits/pdfs_forms/arg160000_fact_sheet.pdf.

Possible solutions to help prevent the release of plastic from landfills can be based on an incorporation of particular BMPs within RCRA. The definition of BMPs could be altered to fit within the purview of RCRA, and include "schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the migration of pollution."²⁰⁶ In practice, BMPs could include additional capping measures, natural and constructed wind barriers, fences to capture blowing debris, similar to yet beyond the access restraints currently required, and sedimentation ponds designed to capture plastic debris that may wash off a landfill during a storm.

Additionally, greater care should be exercised to avoid locating landfills near coastlines or waterways, and thus avoid litter escape to the marine and coastal environment by giving increased local planning and management capacity to the relevant state and local governments.²⁰⁷ To this end, "formulation and implementation of improved management programmes in small rural communities to prevent litter escape into rivers and the marine and coastal environment" would also be beneficial.²⁰⁸ Incentives for compliance may include economic incentives, such as tax benefits, and technical assistance or cooperation, including training of personnel.²⁰⁹ Enforcement will necessarily be accomplished by federal and state inspections, civil enforcement, criminal prosecution, mandatory reporting by the regulated entities, and by citizen suits pursuant to the CWA²¹⁰ and RCRA.²¹¹

Unfortunately, implementing these changes in the United States will be insufficient without similar changes made in the domestic laws of nations around the world, pursuant to amendments to the overarching international agreements. Initial authority for these amendments can be based on the Law of the Sea, particularly Article 207. "Undoubtedly, this provision provides a legal foundation for the protection of the marine environ-

206. 40 C.F.R. § 232.2.

207. See U.N. Env't Programme, UNEP (OCA)/LBAIG.2/7, Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities ¶ 146(e) (Dec. 5, 1995).

208. *Id.* ¶ 146(f).

209. *Id.* ¶ 26(b)(i).

210. 33 U.S.C. § 1365.

211. 42 U.S.C. § 6972. The Court of Appeals for the Ninth Circuit has held that while the RCRA citizen suit provision allows jurisdiction over EPA-approved state programs, this jurisdiction is only on the federal minimum standards; this jurisdiction does not cover state standards that exceed the federal minimums. *Ashoff v. City of Ukiah*, 130 F.3d 409, 412 (9th Cir. 1997).

ment from [land-based sources of pollution].”²¹² Under Article 213, countries are required to enforce their laws and regulations concerning land-based sources of marine pollution that have been adopted in accordance with Article 207.²¹³ “In addition, states must take other necessary measures to implement applicable international rules and standards established through competent international organizations or diplomatic conferences to prevent, reduce, and control [land-based sources of marine pollution].”²¹⁴

Pursuant to Article 207, an amendment should be made to the provisions of the London Convention. Regional marine agreements, such as the Convention for the Protection of the Marine Environment of the North-East Atlantic (“OSPAR Convention”) and the Convention on the Protection of the Marine Environment of the Baltic Sea, could provide useful examples.²¹⁵ “[T]hese conventions oblige states to undertake various measures and programs such as best environmental practice (BEP), best available technology (BAT), and clean technology.”²¹⁶ For example, Annex I of the OSPAR Convention, which deals with “the Prevention and Elimination of Pollution from Land-Based Sources,”²¹⁷ requires signatories to “take, individually and jointly, *all* possible steps to prevent and eliminate pollution from land-based sources.”²¹⁸ In particular, this includes “the use of best available techniques for point sources,” and “best environmental practice for point and diffuse sources,”²¹⁹ which are standards similar to NPDES requirements and WQSS under the CWA. These same standards should be required by the London Convention. Similarly, the London Convention should be amended to include unintentional disposal,²²⁰ and to provide for protection of internal waters of member states.²²¹ Changes to

212. Hassan, *supra* note 118, at 667–68.

213. *Id.* at 669.

214. *Id.*

215. *Id.*

216. *Id.*

217. Convention for the Protection of the Marine Environment of the North-East Atlantic, Sept. 22, 1992, 32 I.L.M. 1072, 1089 [hereinafter *The OSPAR Convention*].

218. *Id.* at 1077 (emphasis added).

219. *Id.* at 1089.

220. *See* London Convention, *supra* note 105, art. 3, § 1.

221. *See id.* at art. 3, § 3. Similar changes should be made to the London Protocol at art. 1, §§ 4 and 7, respectively. *See* London Protocol, *supra* note 106, art. 1, §§ 4 & 7. The London Protocol currently allows member states, “at [their] discretion[, to] either apply the provisions of this Protocol or adopt other effective permitting and regulatory measures to control the deliberate disposal of wastes or other matter in

the international agreements will then need to be approved and implemented by each agreement's members.

IV.

CONCLUSION

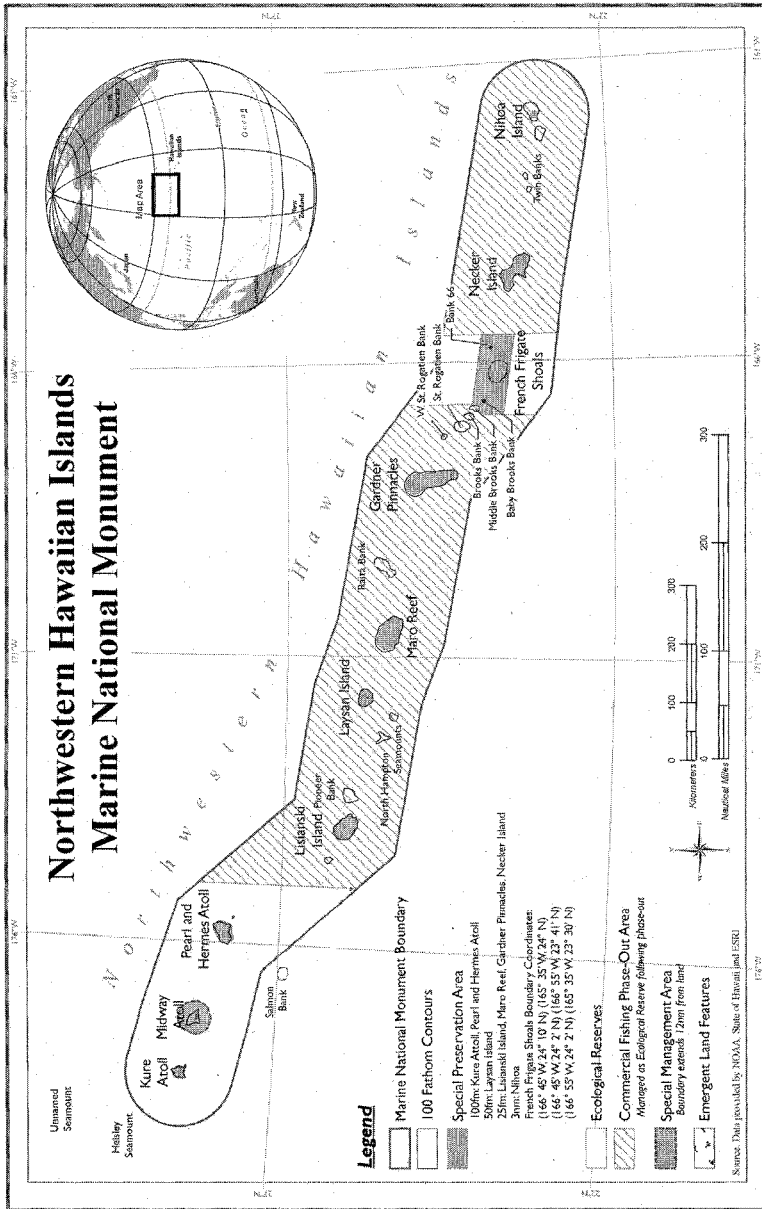
Plastic debris in our oceans harms our environment and the animals that call this planet home. In spite of a significant amount of international and domestic law, the problem progresses unabated, as plastic continues to find its way to the ocean. This is due to a decidedly myopic official position on the source of plastic marine debris. Certainly, sea-focused regulation has helped to decrease the plastic load entering the ocean annually; however, as shown, the primary sources for plastic marine debris—in-land water quality and waste disposal—need to be handled on local, national and international levels.

The regulations currently in place to protect U.S. waters and landfills are inadequate, as plastic continues to make its way to the oceans. Certainly, littering by individuals contributes to this,²²² but additional measures at each stage of the waste stream would help reduce the rate of plastic that ultimately reaches the ocean. Increasing the management practices required of NPDES permitted facilities and expanding TMDLs to include plastics would help create several significant barriers to plastics making it to sea. Additionally, better capping and run-off methods at our landfills, akin to CWA BMPs, would help prevent plastic disposed of in the landfills from escaping. Similar international cooperation will be necessary to affect any significant changes. Amendment of the major agreements mentioned above will be necessary, as well as ratification by the member-states.

marine internal waters where such disposal would be 'dumping' or 'incineration at sea' within the meaning of article 1, if conducted at sea." *Id.* at art. 7, § 2. Member states are also asked to "provide the [IMO] with information on legislation and institutional mechanisms regarding implementation, compliance and enforcement in marine internal waters." *Id.* at art. 7, § 3.

222. To battle littering on an individual level, increased enforcement of littering and illegal dumping should be considered. This would necessarily be done on the local and state level. For background information and case studies, see ENVTL. PROT. AGENCY, EPA905-B-97-001, ILLEGAL DUMPING PREVENTION GUIDEBOOK 23-26 (March 1998), available at http://www.epa.gov/reg5rcra/wptdiv/illegal_dumping/downloads/il-dmpng.pdf.

V. APPENDIX A: MAP OF THE PAPAHAŪNAUMOKUĀKEA MARINE NATIONAL MONUMENT



Source: http://papaahānaumokuākea.gov/maps/Map_of_NWHIMNM.pdf

VI.
APPENDIX B: MIGRATION OF PLASTICS IN THE GPGP
OVER 10 YEARS

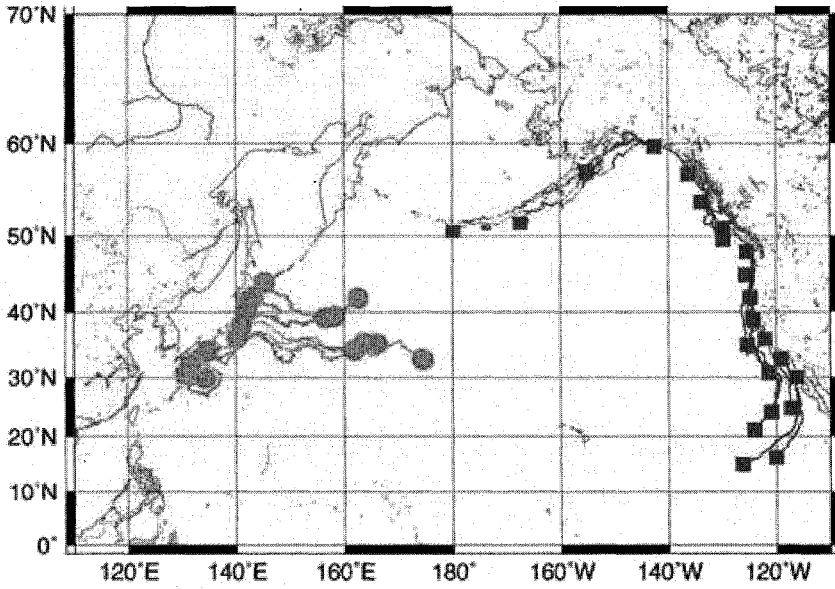


Figure 1: Floatable debris after 183 days

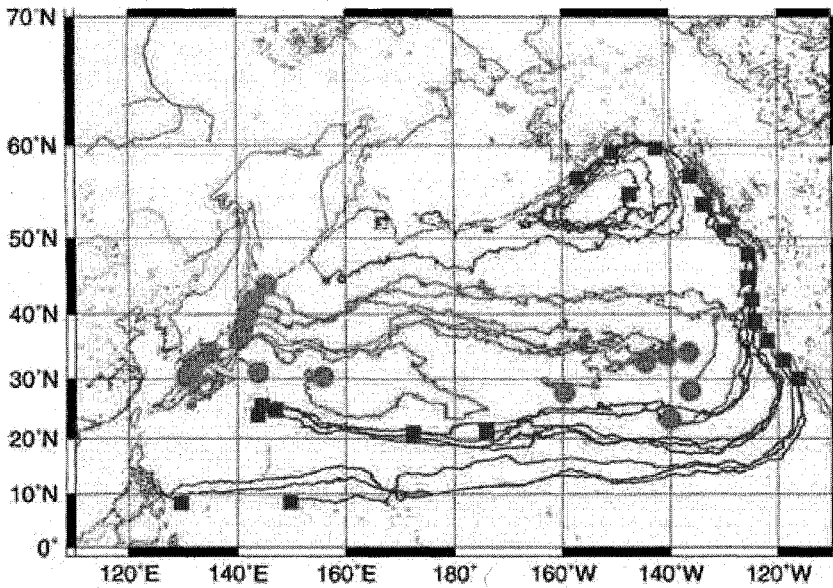


Figure 2: Floatable debris after three years

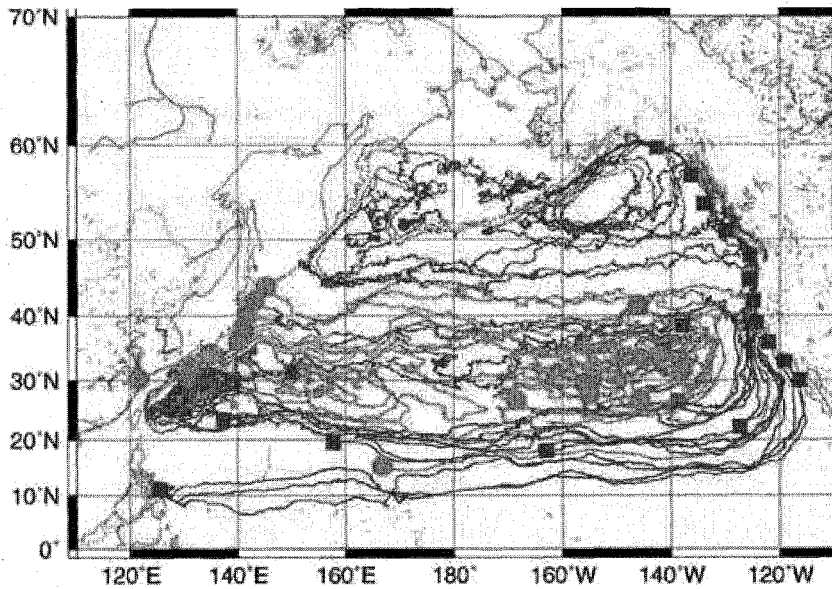


Figure 3: Figure 3: Floatable debris after ten years

Figures 1-3 from *Natural History Magazine* 2003 illustrate the far-reaching effects of marine debris in the oceans. In this map of the North Pacific Ocean, between Japan, Alaska, and the northwest coastline of the U.S., the red and blue dots represent the input points of debris into the ocean. The red and blue lines depict the movement of the debris over time. Figure 1 shows the movement after six months; Figure 2 shows the movement after three years; and Figure 3 displays the movement of the debris after 10 years in the ocean. These images illustrate the scope of marine debris and highlight the fact that international coordination is necessary to effectively address the problem.²²³

223. HETHERINGTON ET AL., *supra* note 193, at 9.

