

Taking the Long View of Ocean Ecosystems: Historical Science, Marine Restoration, and the Oceans Act of 2000

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This is what is threatened today: the ancient, living, sacred sea. A sea which provides the primary source of protein for millions of poor people throughout the world. A sea which has deeply spiritual, as well as practical, importance. Our children may inherit an impostor ocean, a sickly ghost, drained of animal life and crowded with pathogens.¹

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1. OSHA GRAY DAVIDSON, FIRE IN THE TURTLE HOUSE: THE GREEN SEA TURTLE AND THE FATE OF THE OCEAN 48 (2001).

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INTRODUCTION

What could the oceans be if we actively worked to restore them to historical levels of productivity? Would large whales reclaim the deep? Would sea turtles once again swim so thick in Caribbean seas that ships would find it difficult to pass? Would "king cod" once again crowd the waters off the northeastern United States, reaching sizes unseen for decades? Would oysters reclaim Chesapeake Bay in numbers sufficient to filter the bay every three days and to impede navigation? What could the oceans be, if we just let them?

The world's oceans are often viewed as one of the last frontiers of Planet Earth. Vast regions of the seas are still unexplored and only sketchily understood. "We are better informed about the Moon and Mars than about the bottom of the ocean floor; we know more about the life cycle of stars than those of the sperm whale, giant squid, and many of the creatures sought by the world's fishing fleets."² The Senate agrees that "many ocean ecosystems, particularly the ocean's deepest regions, remain undiscovered and unexplored."³

2. COLIN WOODWARD, OCEAN'S END: TRAVELS THROUGH ENDANGERED SEAS 30 (2000).

3. S. REP. NO. 106-301, at 6 (2000), available at http://oceancommission.gov/documents/Senate_Report.pdf.

When viewed from the surface—the limited perspective humans have had for much of history—oceans seem unchanging and inexhaustible, far too grand, too mighty, too deep for beings as puny as humans to damage. This perception has become part of American culture—and part of our national policies and laws for regulating the marine environment. “[C]ultural biases that drive us to think of ocean systems (and sets of exploitable marine resources) differently from the way we think of terrestrial systems”⁴ stem from three sources. First, humans are land creatures, and the oceans are for us “a foreign and dangerous medium,” difficult to explore or understand and hence fear-inducing.⁵ Second, the ocean’s mysteriousness fuels a “paradigm of inexhaustibility”⁶—the notion that “the oceans are so vast and their resources so limitless, that no matter what we do to them they are bound to recover.”⁷ Finally, since at least the seventeenth century, when Hugo Grotius argued “that the seas could not be harmed by human deeds and therefore needed no protection,” a principle of “freedom of the seas” and a view of the oceans as global commons have dominated marine regulation worldwide, including in the United States.⁸ “The seas cannot be owned, they are the quintessential common property. Unfortunately, this perception leads to a prevalent and potentially destructive feeling that because oceans are commons, each man is as free as the next to overexploit and misuse them.”⁹

The United States’ ocean policies and laws are currently rooted in this “paradigm of inexhaustibility.” As a result, they emphasize use instead of protection and preservation, individual resources instead of interconnected ecosystems, problems of recent origin instead of historical accumulations of human-induced marine degradation. Resource regulation, and occasionally even species regulation, is divided among a plethora of state and federal agencies; no single entity or person is charged with looking at the marine environment as a whole. In addition, United States ocean law and policy identify and respond to only relatively

4. TUNDI SPRING AGARDY, *MARINE PROTECTED AREAS AND OCEAN CONSERVATION* 14 (1997).

5. *Id.* at 16.

6. See Robin Kundis Craig, *Sustaining the Unknown Seas: Changes in U.S. Ocean Policy and Regulation Since Rio '92*, 32 ENVTL. L. REP. 10,190, 10,191 (2002) (discussing the “paradigm of inexhaustibility” and its effect on fishing regulation); TUNDI SPRING AGARDY, *supra* note 4, at 24 (“We still tend to think of ocean systems as having limitless resources, with an infinite capacity for resilience in the face of environmental pressures and change.”).

7. AGARDY, *supra* note 4, at 16.

8. COMMITTEE ON THE EVALUATION, DESIGN, AND MONITORING OF MARINE RESERVES AND PROTECTED AREAS IN THE UNITED STATES, NATIONAL RESEARCH COUNCIL, *MARINE PROTECTED AREAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS 2* (2001) [hereinafter *MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS*], available at <http://search.nap.edu/books/0309072867/html/>.

9. AGARDY, *supra* note 4, at 16.

recent causes of marine degradation, implying that humans have been affecting the seas for only a short period of time. For example, coastal population densities have increased noticeably only since the second half of the twentieth century,¹⁰ a relatively recent phenomenon in comparison to other human impacts on the sea, such as fishing. Nevertheless, several federal agencies, in their 2001 *National Coastal Condition Report*, cited population and development pressures as the sources of most problems in the nation's coastal zones.¹¹ Thus, these agencies explained coastal problems solely in terms of relatively recent events, omitting any consideration of humans' longer-term effects on marine ecosystems.

Were the oceans truly inexhaustible, this state of regulatory affairs would not matter. Mounting evidence, however, indicates quite strongly that humans are degrading—sometimes even destroying—large areas of the oceans and the biodiversity they contain. Human activities such as dams, dredging, coastal development and wetland losses, introduced species, tourism and recreational activities usually receive the blame.¹² Because of toxic pollution, state and federal agencies have issued fish consumption advisories for 58 percent of the nation's coastline.¹³ Eutrophic (oxygen-deprived) conditions are increasing, generally as a direct result of marine pollution that causes harmful algal blooms (“HABs”).¹⁴ Every year “[a]pproximately 160,000 factories dump 68,000

10. Excluding Alaska, average coastal population densities increased from 187 people per square mile in 1960 to 273 people per square mile in 1994, and coastal density is expected to reach 327 people per square mile by 2015. Thomas J. Culliton, *Population: Distribution, Density and Growth: National Picture*, in NOAA, STATE OF THE COAST REPORT (1998), at http://state-of-coast.noaa.gov/bulletins/html/pop_01/national.html.

11. The agencies noted:

Because a disproportionate percentage of the nation's population lives in coastal areas, the activities of municipalities, commerce, industry, and tourism have created environmental pressures that threaten the very resources that make the coast desirable. Population pressures include increased solid waste production, higher volumes of urban nonpoint runoff, loss of green space and wildlife habitat, declines in ambient water and sediment quality, and increased demands for wastewater treatment, potable water, and energy supplies.

Development pressures have resulted in substantial physical changes along many areas of the coastal zone. Coastal wetlands continue to be lost to residential and commercial development, while quantity and timing of freshwater flow, critical to river and estuarine function, continue to be altered.

EPA, NOAA, DOI, & USDA, NATIONAL COASTAL CONDITION REPORT 4 (Sept. 2001), available at <http://epa.gov/owow/oceans/nccr/chapters/chap1intro.pdf>. The entire report is available for download through <http://epa.gov/owow/oceans/nccr/downloads.html>.

12. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 13.

13. *Id.* at xv.

14. K.L. Bushaw-Newton & K.G. Sellner, *Harmful Algal Blooms: National Picture*, in NOAA, STATE OF THE COAST REPORT (Dec. 1998), at http://state-of-coast.noaa.gov/bulletins/html/hab_14/national.html; Josie Glausiusz, *Dead Zones*, DISCOVER, Mar. 2000, at 22; Nancy N. Rabelais, *Oxygen Depletion in Coastal Waters: National*

tons of toxic metals and 57,000 tons of toxic organic chemicals” into the U.S. coastal waters.¹⁵ The number of marine species listed for protection under the Federal Endangered Species Act has almost doubled in the last ten years.¹⁶ In addition, marine ecosystems will need to tolerate increasing global temperatures, which are predicted to cause sea levels to rise, increase the frequency of violent storms, and cause abrupt changes in ocean currents.¹⁷ These increasingly obvious environmental problems in the ocean have prompted some to speculate that humans may be causing global ecocide.¹⁸

Of course, the United States’ land territories have also suffered degradation. However, records of the land’s prior condition often survive and provide an historical baseline by which to measure what has been lost. Given our ignorance regarding the oceans, in contrast, such baselines are often missing for marine ecosystems, disguising the loss of productivity and ecosystem function that once existed and may once again be possible.

On land, environmental policy has been undergoing something of a paradigm shift, from a focus on merely halting continuing damage and preserving relatively pristine areas to actively restoring degraded ecosystems.¹⁹ Reworking the traditional paradigms for marine regulation has taken more time. However, as marine degradation and the inadequacy of marine regulation become more obvious, “interest is growing in approaches to ensure the continuing viability of marine ecosystems,”²⁰ including restoration. Declines in biodiversity and commercially important marine species, for example, “have spurred efforts to institute alternative management approaches that will conserve and, where needed, restore biological diversity and productivity.”²¹

Legal developments in the United States reflect this increasing interest in marine restoration. On December 14, 2000, Congress enacted the Coral Reef Conservation Act in order “to preserve, sustain, and

Picture, in NOAA, STATE OF THE COAST REPORT (July 1998), at http://state-of-coast.noaa.gov/bulletins/html/hyp_09/national.html.

15. THOMAS E. SVARNEY & PATRICIA BARNES-SVARNEY, *THE HANDY OCEAN ANSWER BOOK* 431 (2000).

16. In 1992, NOAA considered twenty-three marine species endangered, 50 C.F.R. § 222.23(a) (1992), and eight threatened. 50 C.F.R. § 227.4 (1992). In 2000, in contrast, the list had grown to twenty-nine endangered marine species, 50 C.F.R. § 224.101 (2000), and twenty-eight threatened marine species. 50 C.F.R. § 223.102 (2000).

17. ROBERT KUNZIG, *THE RESTLESS SEA* 266–319 (1999).

18. Ludwik A. Teclaff, *Beyond Restoration—The Case of Ecocide*, 34 *NATURAL RESOURCES J.* 936–37 (1994).

19. Joseph L. Sax, *The New Age of Environmental Restoration*, 41 *WASHBURN L.J.* 1, 1 (2001).

20. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 11.

21. *Id.* at 13.

restore the condition of coral reef ecosystems.”²² The Act complements President Clinton’s June 1998 “Coral Reef Protection” Executive Order, which created the Coral Reef Task Force in order to “develop, recommend, and seek or secure implementation of measures necessary to reduce and mitigate coral reef ecosystem degradation and to restore damaged coral reefs.”²³ Subsequently, in May 2000, President Clinton sought more generally to restore ocean ecosystems through his “Marine Protected Areas” (“MPA”) Executive Order, creating a program to “enhance the conservation of our Nation’s natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations.”²⁴ The Bush Administration adopted this Executive Order²⁵ and began selecting the national MPA Advisory Committee in the summer of 2001.²⁶ The National Oceanic and Atmospheric Administration (“NOAA”) has established a national MPA website,²⁷ which supplies numerous references regarding MPAs²⁸ and the national MPA inventory.²⁹ In the wake of the September 11, 2001, terrorist attacks, however, progress in implementing the MPA Executive Order slowed, and the MPA Advisory Committee was not appointed until January 3, 2003. However, three Fishery Management Councils had MPAs on their agendas in the summer of 2002 and NOAA extensively revised its MPA website in January 2003,³⁰ suggesting that executive interest in the MPA Executive Order is resuming.

Congress took a more substantial step toward ocean restoration in August 2000, when it enacted the Oceans Act,³¹ which reflected Congress’ perception that the United States needed a new and comprehensive

22. 16 U.S.C. § 6401(1) (2000).

23. Exec. Order No. 13,089, § 5(c), 63 Fed. Reg. 32,701, 32,702 (June 11, 1998).

24. Exec. Order No. 13,158, § 1, 65 Fed. Reg. 34,909 (May 26, 2000).

25. Press Release, Donald L. Evans, Secretary of Commerce, Supplement to Executive Order 13,158 (June 4, 2001), available at http://mpa.gov/frontmatter/sup1_eo.html.

26. NOAA, *Marine Protected Areas of the United States: The MPA Advisory Committee*, at <http://www.mpa.gov/mpabusiness/fac.html> (last revised April 22, 2002); see also Nominations for Federal Advisory Committee on Marine Protected Areas, 66 Fed. Reg. 42,204 (Aug. 10, 2001).

27. NOAA, *Marine Protected Areas of the United States*, at <http://www.mpa.gov> (last revised July 9, 2002).

28. NOAA, *Marine Protected Areas of the United States: The MPA Library*, at http://www.mpa.gov/mpaservices/mpa_library.html (last revised Nov. 30, 2001).

29. NOAA, *Marine Protected Areas of the United States: The MPA Inventory*, at http://www.mpa.gov/mpaservices/inv_status/status_inv.html (last revised Nov. 30, 2001).

30. North Pacific Fishery Management Council, 67 Fed. Reg. 34,434 (May 14, 2002); South Atlantic Fishery Management Council, 67 Fed. Reg. 38,260 (June 3, 2002); Western Pacific Fishery Management Council, 67 Fed. Reg. 39,330, 39,331 (June 7, 2002). Under the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. §§ 1801–1883 (2000), eight regional Fishery Management Councils prepare fishery management plans, including amendments, for each fishery within their respective regions (New England, Mid-Atlantic, South Atlantic, Caribbean, Gulf of Mexico, Pacific, North Pacific, and Western Pacific) that “requires conservation and management.” *Id.* § 1851(a), (h)(1).

31. Pub. L. No. 106–256, 114 Stat. 644.

policy for protecting and managing its oceans and their resources. It gave the current administration the power to influence, and perhaps even to set, that new policy. The Oceans Act established the Commission on Ocean Policy,³² which currently is reviewing our national ocean policy. At the end of its review, it will recommend policy and legal reforms to Congress and the President.³³ President George W. Bush appointed the members of the Commission in June 2001,³⁴ and, according to the Act's timetables, President Bush will submit "a statement of proposals to implement or respond to the Commission's recommendations for a coordinated, comprehensive, and long-range national policy for the responsible use and stewardship of ocean and coastal resources for the benefit of the United States"³⁵ to Congress sometime in spring or summer 2003.³⁶

The ocean policy that Congress eventually enacts will both depend upon and circumscribe the restoration goals that our nation chooses to pursue for its marine environments. In combination with the national system of MPAs required by the MPA Executive Order, the Oceans Act could lead to a complete re-visioning of the United States' ocean policies, replacing the current presumption of use with precautionary preservation and restoration, the current fragmentation of regulatory programs with comprehensive and unified regulation, and the current resource-by-resource and species-by-species regulation with an ecosystem approach.

To constitute effective ocean policy, however, "restoration" and "preservation" must be articulated in terms of specific biodiversity and ecosystem goals: restoration to *what* ecological state? *what* level of biological productivity? preservation of *what* existing ecosystem functions? Even if Congress adopts "restoration of the oceans" as U.S. policy and law as a result of the Oceans Act, little will be accomplished for the marine environment if Congress continues to view marine degradation as a short-term problem. This view, encapsulated in the *National Coastal Condition Report's* focus on population pressures as the most important source of coastal degradation, implicitly adopts a relatively recent baseline for ocean productivity and biodiversity and thus imposes *de facto* limitations (both perceptive and legal) on any attempted

32. Details about the Commission on Ocean Policy, including its membership and meeting schedule, can be found at <http://oceancommission.gov> (last updated Sept. 23, 2002).

33. Oceans Act of 2000 §§ 2, 3(a), (f).

34. *Presidential Ocean Commission Panelists Named*, ASCRIBE NEWS, June 18, 2001.

35. Oceans Act of 2000 § 4(a).

36. Under the Act, the Commission must submit its report to Congress and the President within 18 months of its establishment, *id.* § 3(f)(1), or by December 2002. The President will then submit recommendations to Congress "[w]ithin 120 days after receiving and considering the report and recommendation of the Commission." *Id.* § 4(a).

restoration: all we need to do is “solve” the identified recent causes of marine degradation, and we will have healthy marine ecosystems.

A recent scientific study by Jeremy B.C. Jackson and several colleagues suggests a far broader range of possible states for marine ecosystems.³⁷ The study, which appeared in *Science*, applies a centuries-long perspective on anthropogenic (human-induced) changes to the oceans. This temporally-expanded perspective reveals that the traditional scientific view of ocean management, based on short-term studies of changes in marine ecosystems, is inadequate because humans have been altering and weakening complex marine relationships for centuries—ever since we, as a species, learned to fish. According to this study, historical overfishing by humans profoundly disturbed marine ecosystems and greatly reduced ocean productivity long before the twentieth century. As a result, more recent disturbances such as pollution, industrialization, and climate change are, at best, dependent proximate causes of marine ecosystem collapse, and ocean managers cannot “fix” impaired ocean ecosystems unless they also account for historical fishing pressures.

This article argues that the United States should adopt statutory policies to restore marine ecosystems and give them real teeth by incorporating not only the new environmental interest in ecosystems and restoration but also the scientific revelations about ocean baselines and productivity. The resulting federal laws should establish a program that actively pursues aggressive goals for marine restoration based on historical levels of productivity.

Adopting an historical view of the effects of human overfishing on the marine environment will require significant changes to the current system of United States ocean regulation. Specifically, the new policy would require Congress to convert America’s marine environmental law from piecemeal regulation into an integrated, ecosystem-based approach that seeks to restore ocean ecosystems and their resources to states that existed before the intense overfishing of the colonial and modern eras. It would reject the belief that short-term, relatively easy fixes are possible and require the United States to completely reconceptualize the means of achieving the full potential of its marine resources. However, the historical view also would allow policymakers to imagine restoring the oceans to incredible productivity, home to millions of whales and sea turtles and huge schools of large fish, with estuaries carpeted in large oysters and clams, and with the capability of maintaining its overall health and water quality even in the face of anthropogenic stress—a vision of ocean health impossible from a shorter-term perspective.

37. See Jeremy B.C. Jackson et al., *Historical Overfishing and the Recent Collapse of Coastal Ecosystems*, 293 *SCIENCE* 629, 636 (2001).

Ironically, while changes in the regulatory structure of the United States' ocean laws and policies would be enormous, the central premise of the new regime—and the basis of much of the new regulation—should be quite simple: leave a large percentage of the oceans alone, with specific protected areas designated on a scientific basis. Unlike terrestrial ecosystems, too little is known about most marine ecosystems to attempt much active human intervention. Instead, the focus should be on reducing extractive uses and other harmful or polluting activities, such as fishing and land-based water pollution, so that the ocean can restore itself. To this end, Congress should take the opportunity that the Oceans Act presents to transform the MPA Executive Order into binding federal law, creating a network of zoned MPAs that can shelter a variety of important marine ecosystems.

I.
THE CURRENT STATE OF U.S. OCEAN REGULATION

Under international customary law and domestic statutory and Presidential pronouncements, the United States exercises jurisdiction over ocean waters extending 200 miles out from its various coasts and over its continental shelf resources.³⁸ As a result, the United States controls more than four million square miles of ocean³⁹—more marine territory than land territory.⁴⁰ Because of geographic, jurisdictional, and species-specific fragmentation, the United States' current regulatory regime is inadequate to protect and restore marine ecosystems and their biodiversity.

38. In 1976, Congress

passed the Magnuson Fishery Conservation and Management Act, which established a 200-mile exclusive fishing zone for the United States . . . and effectively ensured that 200-mile zones would not only be part of any future law of the seas treaty but would also be accepted in customary international law within a few years.

JOSEPH J. KALO ET AL., *OCEAN AND COASTAL LAW: CASES AND MATERIALS* 336 (1999); see also Magnuson-Stevens Fishery Conservation and Management Act of 1976, Pub. L. No. 94-265, §§ 3, 101, 90 Stat. 331 (enacting the relevant provisions of the Act). Such 200-mile provisions were incorporated into the 1982 United Nations Conference on the Law of the Sea ("UNCLOS III"), through that treaty's provisions allowing nations to declare a 200-mile exclusive economic zone, or EEZ. Third United Nations Conference on the Law of the Sea, Dec. 10, 1982, arts. 55-75, 1833 U.N.T.S. 397 (entered into force Nov. 16, 1994), available at http://www.un.org/Depts/los/convention_agreements/texts/unclos/UNCLOS.pdf.

39. Liza Tewell, *Ocean Act Allows Public Input*, SEATTLE POST-INTELLIGENCER, Aug. 16, 2000, at C5.

40. See *Profile of the U.S.: Geography*, at <http://www.infoplease.com/ipa/A0004924.html> (last visited Oct. 10, 2002) (noting that federal public lands comprise only 3,794,083 square miles).

A. *Shortcoming #1: Geographic Fragmentation of Ocean Management*

Current U.S. ocean regulation arbitrarily fragments marine resources geographically, ignoring ecosystem connections. Part of this geographic fragmentation reflects international law, which recognizes several zones in the ocean and gives coastal nations varying degrees of regulatory authority over those zones. The 1982 United Nations Convention on the Law of the Sea (“UNCLOS III”), which came into force in 1994, establishes several zones of national regulatory control over the sea. The twelve miles of ocean closest to shore are a coastal nation’s territorial sea, where the coastal nation exercises sovereign control over the waters, the airspace, the seabed, and the subsoil.⁴¹ The next twelve miles out are the contiguous zone, a zone of extended enforcement jurisdiction to aid nations in regulating activities in the territorial sea,⁴² such as when fishing vessels violate the law within the territorial sea and then try to escape seaward. In the exclusive economic zone (“EEZ”), which extends out to 200 miles from shore, the coastal nation has “sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living,” in the waters, seabed, and subsoil.⁴³ In addition, the coastal nation has jurisdiction over research and conservation in the EEZ and the right to explore and exploit the EEZ economically.⁴⁴ Finally, UNCLOS III gives signatory nations “the exclusive right to authorize and regulate drilling on the continental shelf for all purposes,”⁴⁵ although other nations can lay cables and pipes over the continental shelf.⁴⁶

The United States has not ratified UNCLOS III.⁴⁷ However, in 1983, President Reagan proclaimed a 200-mile EEZ for the United States for

41. Convention on the Law of the Sea, Dec. 10, 1982, arts. 2.1, 2.2, 3, 1833 U.N.T.S. 397 (entered into force Nov. 16, 1994), available at http://www.un.org/Depts/los/convention_agreements/texts/unclos/UNCLOS.pdf.

42. *Id.* art. 33.

43. *Id.* arts. 56.1, 57.

44. *Id.* art. 56.1.

45. *Id.* art. 81.

46. *Id.* art. 79.1.

47. There have been several calls over the last decade for the United States to ratify the United Nations Convention on the Law of the Sea—including, most recently, from the Commission on Ocean Policy itself. See U.S. COMMISSION ON OCEAN POLICY, RESOLUTION ON UNITED NATIONS LAW OF THE SEA CONVENTION (Nov. 14, 2001), available at http://oceancommission.gov/documents/los_resolution.pdf; Brett Wagner & Philip Lofrumenco, *It's Time for the United States to Ratify the Law of the Sea Treaty*, SALT LAKE TRIB., Sept. 19, 1999, at AA6; John H. Dalton, *Ratify the Law of the Sea Treaty*, PORTLAND OREGONIAN, July 20, 1998, at B7; George Galdorsi, *Time to Ratify the Law of the Sea Treaty*, CHRISTIAN SCI. MONITOR, Apr. 5, 1996, at 19; Carl Hartman, *U.S. Military Wants Law of the Sea Ratified*, ASSOCIATED PRESS, June 30, 1995; Press Release, Senator Claiborne Pell, *United States Ratification of the Law of the Sea Convention Will Enhance Our National Security Interests*, June 28, 1995; Press Release, Senator Claiborne Pell, *Ratification of the United Nations Convention on the Law of the Sea Will Promote the Economic Interests of the United States*, May 16, 1995;

all purposes.⁴⁸ Five years later, he proclaimed a 12-mile territorial sea for the United States.⁴⁹ President Clinton added a contiguous zone extending to 24 miles in 1999.⁵⁰ As a result, the United States has more or less adopted the UNCLOS III scheme of geographic division in ocean regulation.

Domestic law adds another layer of geographical fragmentation in marine regulation. Under the Federal Submerged Lands Act of 1953,⁵¹ coastal states received title to the lands beneath coastal waters at least three miles out to sea.⁵² Title to the submerged lands gives states regulatory control over activities such as fishing in the coastal waters above those lands,⁵³ although this control is subject to the federal government's regulation of "commerce, navigation, national defense, and international affairs . . ."⁵⁴ Thus, the first three miles of coastal waters are primarily the states' to regulate, which fragments marine ecosystems not just at the three-mile line but also repeatedly along the coast where state borders extend out to sea.

Ocean-oriented federal statutes incorporate these arbitrary lines, providing different levels of protection for different geographic regions, regardless of whether they have any correlation to the ocean's ecology. For example, under the Federal Clean Water Act,⁵⁵ various zones of the ocean are subject to different kinds of regulation. The Act primarily prohibits "the discharge of any pollutant by any person" except in compliance with its provisions.⁵⁶ "Discharge of a pollutant" "means (A) any addition of any pollutant to *navigable waters* from any point source, (B) any addition of any pollutant to the *waters of the contiguous zone or the ocean* from any point source other than a vessel or other floating craft."⁵⁷ "Navigable waters" are "the waters of the United States,

Editorial, *Time to Ratify the Law of the Sea*, ST. LOUIS POST-DISPATCH, Aug. 19, 1994, at 6C. However, as of September 27, 2002, the United States still has not ratified the treaty. UNITED NATIONS, STATUS OF THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA 10, available at http://www.un.org/Depts/los/reference_files/status2002.pdf (last revised Sept. 27, 2002).

48. Exclusive Economic Zone of the United States of America, Proclamation No. 5,030, 48 Fed. Reg. 10,605 (Mar. 10, 1983).

49. Territorial Sea of the United States of America, Proclamation No. 5,928, 54 Fed. Reg. 777 (Dec. 27, 1988).

50. Contiguous Zone of the United States, Proclamation No. 7,219, 64 Fed. Reg. 48,701 (Aug. 2, 1999).

51. 43 U.S.C. §§ 1301–1303, 1311–1315 (2000).

52. 43 U.S.C. § 1301(a)(2) (2000). States with historical claims to more ocean territory were also free to press those claims against the Federal Government. 43 U.S.C. §§ 1301(a)(2), 1312 (2000).

53. 43 U.S.C. § 1311–12 (2000).

54. 43 U.S.C. § 1314(a) (2000).

55. 33 U.S.C. §§ 1251–1387 (2000).

56. 33 U.S.C. § 1311(a) (2000).

57. 33 U.S.C. § 1362(12) (2000) (emphasis added).

including the territorial seas.”⁵⁸ For purposes of the Act, however, the territorial seas are not the 12-mile zone recognized under international law, but rather the first three miles of ocean that the states control pursuant to the Submerged Lands Act.⁵⁹

For all point sources, regardless of where they discharge, the EPA sets technology-based effluent limitations, which generally impose numeric discharge standards for particular pollutants.⁶⁰ For the navigable waters, including the state-controlled territorial sea, states set water quality standards.⁶¹ The standards “consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses,”⁶² as well as an antidegradation policy that limits further deterioration in water quality.⁶³ Unlike effluent limitations, state-set water quality standards also trigger a host of other protections under the Act. For example, the EPA must set numerical effluent limitations sufficient to meet the water quality standards.⁶⁴ States must also set total maximum daily loads (“TMDLs”) of pollutants for any water body or segment that does not meet its water quality standards.⁶⁵

The Clean Water Act does not require water quality standards for marine waters beyond the state’s territorial sea. Nevertheless, the Act does apply beyond the first three miles of ocean water,⁶⁶ requiring the EPA to set ocean discharge criteria based on the “acceptable” “degradation of the waters of the territorial seas, the contiguous zone,

58. 33 U.S.C. § 1362(7) (2000).

59. See 33 U.S.C. § 1362(8) (2000) (defining “territorial seas” as “the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles.”).

60. 33 U.S.C. §§ 1311(b), 1362(11) (2000).

61. 33 U.S.C. § 1313(a), (b), (c) (2000).

62. 33 U.S.C. § 1313(c)(2)(A) (2000).

63. 33 U.S.C. § 1313(d)(4)(B) (2000); 40 C.F.R. § 131.12 (2001). In establishing water quality standards, the states must take “into consideration [the waters’] use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also tak[e] into consideration their use and value for navigation.” 33 U.S.C. § 1313(c)(2)(A).

64. 33 U.S.C. § 1312(a) (2000).

65. 33 U.S.C. § 1313(d)(1)(A) (2000).

66. 33 U.S.C. §§ 1362(12), 1362(10), 1362(9) (2000) (defining “discharge of a pollutant” to include non-vessel discharges into the “contiguous zone” and the “ocean,” then defining those two terms specifically to embrace waters more than three miles out to sea). Although the Act defines the “ocean” to be “any portion of the high seas beyond the contiguous zone,” 33 U.S.C. § 1362(10) (2000), the United States lacks the power under international law to regulate beyond the 200-mile EEZ. See JOSEPH J. KALO ET AL., *COASTAL AND OCEAN LAW: CASES AND MATERIALS* 314–16, 339–40 (1999) (describing international law and the 200-mile limit). Therefore, as a practical matter, the Clean Water Act’s “ocean” stretches from the outer boundary of the contiguous zone (12 miles out under the original United Nations Convention on the Law of the Sea, 24 miles under UNCLOS III) out to 200 miles offshore. *Id.* at 339–40.

and the oceans.”⁶⁷ The EPA promulgated the current ocean discharge criteria in 1980.⁶⁸

Therefore, the EPA-set effluent limitations, the state-set water quality standards, including the antidegradation policy, *and* the EPA-set ocean discharge criteria all apply in the statutory three-mile territorial sea. In contrast, only the effluent limitations and the ocean discharge criteria are relevant in the contiguous zone and the ocean. Moreover, the additional protections that follow from water quality standards, such as water-quality-based effluent limitations and TMDLs, apply in the territorial sea but *not* in the contiguous zone or the ocean.⁶⁹ As a result, the oceans beyond the territorial sea lack the basic goals for water quality—and the means of enforcing those goals—that water quality standards provide for all other “waters of the United States.” The Clean Water Act thus prescribes a water quality regime where water quality protection arbitrarily changes three miles out to sea, indicating that the last 197 miles of ocean that the United States controls are significantly less important than the first three, regardless of these outer waters’ ecological connection to the three-mile coastal zone.

67. 33 U.S.C. § 1343(c)(1) (2000). Ocean discharge criteria must take into account:

- (A) the effect of disposal of pollutants on human health or welfare, including but not limited to plankton, fish, shellfish, wildlife, shorelines, and beaches;
- (B) the effect of disposal of pollutants on marine life including the transfer, concentration, and dispersal of pollutants or their byproducts through biological, physical, and chemical processes; changes in marine ecosystem diversity, productivity, and stability; and species and community population changes;
- (C) the effect of disposal of pollutants on esthetic, recreation, and economic values;
- (D) the persistence and permanence of the effects of disposal of pollutants;
- (E) the effect of the disposal at varying rates, of particular volumes and concentrations of pollutants;
- (F) other possible locations and methods of disposal or recycling of pollutants including land-based alternatives; and
- (G) the effect on alternate uses of the oceans, such as mineral exploitation and scientific study.

Id.

68. Ocean Discharge Criteria, 45 Fed. Reg. 65,942, 65,942 (Oct. 3, 1980) (codified at 40 C.F.R. pt. 125 (2001)). EPA sought to amend the ocean discharge criteria in January 2001, but the proposal was stalled as the Bush Administration replaced the Clinton Administration. See generally ENVIRONMENTAL PROTECTION AGENCY, OCEAN DISCHARGE CRITERIA: REVISIONS TO THE OCEAN DISCHARGE CRITERIA REGULATIONS (2001), available at http://www.epa.gov/owow/oceans/protecting_oceans/cwa403rule.pdf. In December 2001, EPA announced that it would propose its new ocean discharge criteria in April 2002, with final rules expected to issue in April 2003. 66 Fed. Reg. 62,368, 62,370 (Dec. 3, 2001). However, as of January 2003, EPA still had not proposed the new criteria.

69. See Robin Kundis Craig & Sarah Miller, *Ocean Discharge Criteria and Marine Protected Areas: Ocean Water Quality Protection Under the Clean Water Act*, 29 B.C. ENVTL. AFFAIRS L. REV. 1, 37–44 (2001) (discussing the lack of applicability of water quality provisions to the ocean beyond the statutory territorial sea).

The arbitrary geographic fragmentation of the United States' ocean territories does little to promote protection and restoration of marine ecosystems, and it may even actively hinder restoration efforts. As scientists have noted,

[t]he sea is not a uniform, limitless expanse, but a patchwork of habitats and water masses occurring at scales that render them vulnerable to disturbance and depletion. The patchiness of the ocean is well known by fishers who do not cast their nets randomly but seek out areas where fish are abundant.⁷⁰

As the Clean Water Act demonstrates, however, instead of addressing this patchy sea on an ecological basis, American law ensures that multiple governments and agency bureaucracies, often with different and perhaps even competing regulatory priorities, will govern almost any marine ecosystem. In the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, for example, the federal government has prohibited fishing in large areas around each island atoll in an attempt to protect the entire coral reef ecosystem, but the State of Hawai'i originally allowed fishing and other extractive uses in the first three miles of ocean around each island, arguably undermining the federal protections.⁷¹

B. Shortcoming #2: Regulatory Fragmentation and Complexity

In addition to fragmenting oceans geographically, current United States policy regarding ocean resources preserves various governments' and agencies' jurisdictional "turf" among a myriad of regulatory programs instead of regulating similar activities comprehensively under a single management regime.⁷²

1. Offshore Oil and Gas Regulation

Offshore drilling for oil and gas provides one example of this jurisdictional complexity. States have authority under the Submerged Lands Act to license the oil and gas extraction within three miles of

70. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 2.

71. Cha Smith, KAHEA; Stephanie Fried, Environmental Defense; & Dave Raney, *Press Release: State Proposes Strong Protections for Northwestern Hawaiian Islands in Response to Outpouring of Public Support and in Recognition of Existing Protections in Surrounding Federal Waters* (Aug. 12, 2002), at 1, available at http://www.kahea.org/NWHI_PDFS/press-dlnr_regs-8-22.pdf.

72. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 3.

[R]esponsibility for regulating activities in marine areas, extending from estuarine watersheds to deep ocean, is fragmented among a daunting number of local, state, federal, and international entities. This complexity in jurisdictional responsibility often places a major barrier to developing coordinated policies for managing ocean resources across political boundaries.

shore. More than three miles out to sea, however, the intricate provisions of the Federal Outer Continental Shelf Lands Act⁷³ apply, implemented through the Minerals Management Service of the Department of the Interior.⁷⁴ If exploration or drilling in federal waters will affect the waters of the state's three-mile coastal zone and the state has complied with the Federal Coastal Zone Management Act,⁷⁵ however, the state must agree that the exploration and drilling are consistent with its coastal zone management plan before such activities can proceed.⁷⁶ In either location, if offshore drilling requires platforms that might interfere with navigation, or if the exploration and drilling involves the discharge of dredged or fill material, the Army Corps of Engineers must determine whether to permit the activity pursuant to the Federal Rivers and Harbors Act⁷⁷ and the Clean Water Act.⁷⁸ If the drilling facilities also discharge pollutants into the ocean, as through a sewage or wastewater discharge pipe, then the EPA (or a delegated state) will also have authority to regulate the project under the Clean Water Act.⁷⁹ A single, comprehensive, ecosystem-based review of offshore oil and gas activities would not only better ensure review of the project's cumulative environmental impacts but also streamline the permitting process for oil companies.

2. *Marine Water Pollution*

Regulatory fragmentation is even more pronounced with respect to marine pollution. Under the Clean Water Act, land-based point sources—"any discernible, confined, and discrete conveyance,"⁸⁰ like seaside factories with effluent pipes reaching out to the ocean—or vessels and floating craft that discharge pollutants into the first three miles of ocean generally must obtain a National Pollutant Discharge Elimination System ("NPDES") permit from either EPA or the relevant state (if the state has been delegated permitting authority).⁸¹ If the point source is discharging dredged or fill material into the navigable waters, however,

73. 43 U.S.C. §§ 1331–1356 (2000).

74. See 43 U.S.C. §§ 1331(b), 1334 (2000) (giving authority to administer the OCSLA leasing program to the Secretary of the Interior); 30 C.F.R. § 250.101 (2001) (delegating the Secretary's OCSLA authority to the Minerals Management Service).

75. 16 U.S.C. §§ 1451–1465 (2000).

76. See 16 U.S.C. § 1456(c)(3)(B) (2000).

77. 33 U.S.C. § 403 (2000) (prohibiting construction of obstructions in navigable waters without a permit from the Army Corps of Engineers).

78. See 33 U.S.C. § 1344(a), (d) (2000) (requiring permits from the Army Corps of Engineers for discharges of dredged or fill material into navigable waters).

79. 33 U.S.C. §§ 1251(d), 1311(a), 1342(a), 1344(b) (2000).

80. 33 U.S.C. § 1362(14) (2000).

81. See 33 U.S.C. §§ 1311(a), 1342(a), (b) (2000).

its permit must come from the Army Corps of Engineers.⁸² Conversely, land-based nonpoint sources, such as agricultural stormwater runoff, are directly regulated, if at all, only under state nonpoint source management plans and regulations.⁸³

Vessel water pollution regulation is even more complex. Vessels and other floating craft discharging pollutants beyond the first three miles of sea are not subject to the Clean Water Act's NPDES permit requirement, although vessel sewage *is* regulated jointly by the EPA and Coast Guard under a different section of the Clean Water Act.⁸⁴ Titles I and II of the Marine Protection, Research and Sanctuaries Act,⁸⁵ also known as the Ocean Dumping Act, govern ocean dumping and incineration at sea of materials other than vessel sewage waste.⁸⁶ Under this Act, the Army Corps issues permits for ocean dumping of dredged materials, while the EPA issues permits for dumping of all other materials.⁸⁷ However, the Coast Guard regulates disposal of garbage generated on vessels pursuant to the Marine Plastic Pollution Research and Control Act of 1987,⁸⁸ which prohibits disposal of plastics, including plastic fishing nets. Pursuant to the Ports and Waterways Safety Act, as amended by the Port and Tanker Safety Act of 1978,⁸⁹ NOAA imposes construction requirements on cargo vessels that carry oil or hazardous substances, but the EPA oversees liability for such spills—hazardous substance spills pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (“CERCLA”),⁹⁰ and oil spill liability pursuant to the Oil Pollution Act of 1990.⁹¹ Finally, ships' releases of alien invasive species—such as the zebra mussels that have wreaked havoc in the Great Lakes⁹²—

82. 33 U.S.C. § 1344(a), (d) (2000). States can acquire the authority to issue some “dredge or fill” permits. *Id.* § 1344(h). Despite the EPA's encouragement of such assumption, however, as of July 2002 only two states, Michigan and New Jersey, had actually assumed the section 404 permit programs. EPA, *State or Tribal Assumption of the Section 404 Permit Program* (last updated July 3, 2002), at <http://www.epa.gov/owow/wetlands/facts/fact23.html>.

83. The federal government *has* tried to encourage states to enact such nonpoint source regulations, through both the Clean Water Act, 33 U.S.C. § 1329(b) (2000), and the Federal Coastal Zone Management Act, 16 U.S.C. § 1455 (2000). In addition, nonpoint sources can be indirectly affected by the Clean Water Act's TMDL program, 33 U.S.C. § 1313(d) (2000), but that program only applies to waters that do not meet the water quality standards, 33 U.S.C. § 1313(d)(1) (2000), and a given TMDL need not address nonpoint source pollution if increased regulation of point sources will allow the waterbody in question to meet the water quality standards. *See* 33 U.S.C. § 1313(d)(3), (4), (e)(3)(A) (2000).

84. *See* 33 U.S.C. § 1322(b)(1) (2000).

85. 33 U.S.C. §§ 1401–1445 (2000).

86. *See* 33 U.S.C. § 1402(c) (2000) (defining “material” to exclude “sewage from vessels”).

87. 33 U.S.C. §§ 1412 (EPA-issued permits), 1413 (Army Corps-issued permits) (2000).

88. 33 U.S.C. §§ 1901–1912 (2000).

89. 33 U.S.C. §§ 1221–1232 (2000).

90. 42 U.S.C. §§ 9601–9674 (2000).

91. 33 U.S.C. §§ 2701–2761 (2000).

92. *See, e.g.*, 16 U.S.C. § 4701(a)(3)-(9) (2000) (announcing congressional findings on damage from the zebra mussel invasions).

are governed by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990⁹³ and the National Invasive Species Act of 1996,⁹⁴ which distribute regulatory responsibility among NOAA,⁹⁵ the EPA,⁹⁶ the Army Corps of Engineers,⁹⁷ the United States Fish and Wildlife Service,⁹⁸ the Coast Guard,⁹⁹ and the Secretary of Agriculture.¹⁰⁰

Who regulates marine pollution, therefore, currently depends on the source of the pollution, the exact nature of the discharge, and the location of the discharge. A more rational regulatory scheme would regulate all sources of marine pollution under one permit program, allowing comprehensive review of all sources of pollution into a given marine ecosystem.

3. *Lack of Regulatory Coordination*

Because of the sheer number of marine regulatory programs and agencies, the Committee on the Evaluation, Design, and Monitoring of Marine Reserves and Protected Areas of the United States, part of the National Research Council, stated in its 2001 review of the United States' marine ecosystems that "[s]hortcomings in marine resource management also derive from inadequate coordination among agencies charged with these responsibilities."¹⁰¹ It explains that "[j]urisdictional issues may be significant for migratory stocks [of fish], especially coastal stocks that cross the boundary between state and federal waters at 3 miles from shore (for most states)."¹⁰² More generally, it notes that "[f]rustration arises when conventional approaches fragment management into a myriad of regulations from multiple state and federal agencies, each addressing only one component of the problem."¹⁰³ For example, in the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, the Marine Mammal Commission supports marine reserves that prohibit all fishing because of its concern that lobster fishing is harming the already-endangered Hawaiian monk seal, while the Western Pacific Regional Fishery Management Council, one of the regulatory bodies created by the Magnuson-Stevens Fishery Management Act, is fighting to weaken the

93. Pub. L. No. 101-646, 104 Stat. 4761 (Nov. 29, 1990) (codified in scattered sections of 16 U.S.C. §§ 4701-4751 (2000)).

94. Pub. L. No. 104-332, 110 Stat. 4073 (Oct. 36, 1996) (codified in scattered sections of 16 U.S.C. §§ 4713-4714 (2000)).

95. 16 U.S.C. §§ 4702(15), 4721(b)(2) (2000).

96. 16 U.S.C. § 4721(b)(3) (2000).

97. 16 U.S.C. §§ 4702(2), 4721(b)(5) (2000).

98. 16 U.S.C. §§ 4702(4), 4721(b)(1) (2000).

99. 16 U.S.C. §§ 4702(12), 4721(b)(4) (2000).

100. 16 U.S.C. § 4721(b)(6) (2000).

101. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 175.

102. *Id.* at 39.

103. *Id.* at 175.

marine reserve protections already in place so that fishing can resume and even expand in those areas.¹⁰⁴

C. Shortcoming #3: Resource-by-Resource and Species-by-Species Regulation

Current United States ocean policy and law regulate ocean resources—particularly marine living resources—almost completely independently of each other and almost completely without regard to the marine ecosystems of which they are a part. Although ocean resources are directly interconnected and mutually influential, U.S. law regulates ocean resources on a resource-by-resource and often on a species-by-species basis rather than on a comprehensive ecosystem basis.

United States law regulates each type of marine resource or use under a separate regulatory regime: the Outer Continental Shelf Lands Act¹⁰⁵ governs oil and gas exploration and development more than three miles out to sea; the Clean Water Act¹⁰⁶ and a plethora of other statutes¹⁰⁷ govern water quality; the Coastal Zone Management Act¹⁰⁸ encourages states to enact coastal zone management plans;¹⁰⁹ the Rivers and Harbors Act¹¹⁰ preserves navigability; the Magnuson-Stevens Fishery Conservation and Management Act¹¹¹ regulates fisheries; the Marine Mammal Protection Act¹¹² governs all marine mammals; and the Endangered Species Act¹¹³ regulates endangered species, including marine endangered species. Thus, resource-by-resource regulation—not ecosystem-based regulation—is the rule.

Moreover, coordination among these regulatory regimes, while occasionally direct and powerful,¹¹⁴ is more often indirect and aspirational. For example, the connection between ocean water quality and the health of the organisms that live there would seem to be direct and undeniable. Indeed, the Clean Water Act acknowledges this

104. Marine Mammal Commission, Letter to Robert P. Smith, Reserve Coordinator, Northwest Hawaiian Islands Coral Reef Ecosystem Reserve (May 23, 2002), at 2, available at http://www.kahea.org/NWHI_PDFS/MMC_Ltr_A_052902.pdf_1.pdf.

105. 43 U.S.C. §§ 1331–1356 (2000).

106. 33 U.S.C. §§ 1251–1387 (2000).

107. See discussion *supra* notes 74–94 and accompanying text.

108. 16 U.S.C. §§ 1451–1465 (2000).

109. 16 U.S.C. § 1455 (2000).

110. 33 U.S.C. §§ 401–418 (2000).

111. 16 U.S.C. §§ 1801–1883 (2000).

112. 16 U.S.C. §§ 1361–1421h (2000).

113. 16 U.S.C. §§ 1531–1544 (2000).

114. For example, Congress has dictated that relevant states must concur in exploration plans for oil and gas leases under the Outer Continental Shelf Lands Act if those relevant states have approved coastal zone management plans pursuant to the Coastal Zone Management Act. 43 U.S.C. § 1340(c)(2) (2000).

connection in several of its provisions.¹¹⁵ Nevertheless, the Clean Water Act's NPDES program rests not on ecosystem and biological considerations for overall water quality but rather on technology-based effluent limitations that limit the particular amounts of pollutants allowed in a particular polluter's discharge.¹¹⁶ In other words, the day-to-day focus of the Clean Water Act is on the polluter, not on the water body.¹¹⁷ Permits start with industry-specific, technology-based effluent limitations;¹¹⁸ only if these limitations are insufficient to achieve the desired water quality standards does the EPA adjust the general requirements.¹¹⁹ Enforcement, too, focuses on the failure to obtain a permit or violation of permit conditions.¹²⁰ Damage to aquatic organisms

115. For example, the Clean Water Act sets as one of its earliest "national goal[s]," "that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife . . . be achieved . . ." 33 U.S.C. § 1251(a)(2) (2000). Similarly, states must establish water quality standards "taking into consideration [a waterbody's] use and value for . . . propagation of fish and wildlife," 33 U.S.C. § 1313(c)(2)(A) (2000), and they must set thermal standards that "assure protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife." 33 U.S.C. § 1313(d)(1)(B), (D) (2000).

[W]henever . . . discharges of pollutants from a point source or group of point sources . . . would interfere with the attainment or maintenance of that water quality in a specific portion of the navigable waters which shall assure . . . the protection and propagation of a balanced population of shellfish, fish, and wildlife,

the EPA must set special effluent limitations for those point sources so that the required level of water quality will be achieved. 33 U.S.C. § 1312(a) (2000). The EPA must develop water quality criteria

reflecting the latest scientific knowledge . . . on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation which may be expected from the presence of pollutants in any body of water

and "on the effects of pollutants on biological community diversity, productivity, and stability . . ." 33 U.S.C. § 1314(a)(1)(A), (C) (2000). It must also publish information "on the factors necessary for the protection and propagation of shellfish, fish, and wildlife" for various kinds of waters. 33 U.S.C. § 1314(a)(2)(B) (2000). Finally, as has been noted, the EPA-set ocean discharge criteria must address "the effect of disposal of pollutants on marine life, including the transfer, concentration, and dispersal of pollutants and their byproducts through biological, physical, and chemical processes; changes in marine ecosystem diversity, productivity, and stability; and species and community population changes . . ." 33 U.S.C. § 1343(c)(1)(B) (2000).

116. See 33 U.S.C. § 1311(b) (2000) (noting that the Act's prohibition on discharges of pollutants will be carried out through effluent limitations, and requiring the EPA to set a variety of such effluent standards based on the type of point source and the level of technology required); 33 U.S.C. § 1342(a)(1)(A) (2000) (listing, as permit requirements, the sections of the Act addressing effluent limitations and ocean discharge criteria but *not* the section regarding water quality standards).

117. See 33 U.S.C. § 1311(a) (2000) (providing that, except as in compliance with the Act, "the discharge of any pollutant by any person shall be unlawful").

118. 33 U.S.C. § 1311(b) (2000).

119. 33 U.S.C. § 1312(a) (2000).

120. 33 U.S.C. §§ 1319(a)(1), (b), (c)(1)(A), (c)(2)(A), (d), (g)(1)(A) (2000); 33 U.S.C. § 1365(a)(1), (f) (2000).

is not even a factor in setting civil penalties, except perhaps under the catch-all factor of "such other matters as justice may require."¹²¹

The limited connection between the Clean Water Act and aquatic species has become even clearer in litigation. For instance, when the State of Washington attempted to impose a minimum stream flow condition on a dam project in order to ensure sufficient water quantity and quality for fish, it had to defend its authority to do so all the way to the Supreme Court.¹²² The EPA's attempt to condition delegation of Clean Water Act permitting authority on states' commitment to use the Clean Water Act to protect water-dependent endangered species was even less successful. The Fifth Circuit invalidated the condition as being beyond the EPA's authority.¹²³

For marine species, the focus is often species-specific, protecting individual species from threats particular to each but ignoring ecosystem-wide interactions among species. For example, the primary federal statute governing fisheries is the Magnuson-Stevens Fishery Conservation and Management Act.¹²⁴ The Act recognizes the importance of fish to the people of the United States, proclaiming that "[t]he fish off the coasts of the United States, the highly migratory species of the high seas, and the species which dwell on or in the Continental Shelf appertaining to the United States, and the anadromous species which spawn in United States rivers or estuaries" "contribute to the food supply, economy, and health of the Nation and provide recreational opportunities."¹²⁵

While the Act acknowledges that certain fish stocks are in trouble, until 1996 it tied the sources of this trouble exclusively to recent overfishing by both domestic and foreign commercial fishers.¹²⁶ The Act proclaimed that sound fisheries management could restore all to rights if

121. See 33 U.S.C. § 1319(d) (2000).

In determining the amount of a civil penalty the court shall consider the seriousness of the violation or violations, the economic benefit (if any) resulting from the violation, any history of such violations, any good-faith efforts to comply with the applicable requirements, the economic impact of the penalty on the violator, and such other matters as justice may require.

Id.

122. PUD No. 1 of Jefferson County v. Washington Dep't of Ecology, 511 U.S. 700 (1994).

123. American Forest & Paper Ass'n v. EPA, 137 F.3d 291, 297-98 (5th Cir. 1998). *But see* American Iron & Steel Inst. v. EPA, 115 F.3d 979, 1002-03 (D.C. Cir. 1997) (upholding the EPA's authority to require compliance with the Endangered Species Act in EPA's Great Lakes water quality guidance).

124. 16 U.S.C. §§ 1801-1883 (2000).

125. 16 U.S.C. § 1801(a)(1) (2000).

126. Because of increased fishing pressure and the inadequacy of fishery conservation and management practices and controls, certain stocks of such fish have been overfished to the point where their survival is threatened, and other stocks have been so substantially reduced in number that they could become similarly threatened. 16 U.S.C. § 1801(a)(2) (2000). In addition, "[t]he activities of massive foreign fishing fleets in waters adjacent to [the United States'] coastal areas have contributed to such damage . . ." 16 U.S.C. § 1801(a)(3) (2000).

implemented “before overfishing has caused irreversible effects,”¹²⁷ a clear declaration of the congressional belief that harm to United States fisheries was a relatively recent phenomenon and still fairly easily correctable.

For the most part, Congress ignored the larger marine environment in the pre-1996 Act, instead focusing almost exclusively on individual stocks and fisheries. In both versions, the Act establishes eight Fishery Management Councils based on geographic regions,¹²⁸ each of which prepares a Fishery Management Plan (“FMP”) for “each fishery under its authority that requires conservation and management.”¹²⁹ A “fishery” is defined as “one or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics.”¹³⁰ As a result, fishery conservation and management under the Act focus on one or a very small number of closely related fish species.

In the pre-1996 Act, Congress did insist that fishery conservation and management be based on “the best scientific information available.” However, the only science it deemed relevant was science related directly to fishing itself—that is, science that “considers the effects of fishing on immature fish and encourages development of practical measures that . . . avoid unnecessary waste of fish.”¹³¹ Congress’s other references to the larger marine environment were similarly attenuated.¹³² Perhaps most significantly, before 1996 the Secretary of Commerce, acting through NOAA and the National Marine Fisheries Service (“NMFS”), was

127. 16 U.S.C. § 1801(a)(5) (2000).

128. Pub. L. No. 94-265, § 302(a), 90 Stat. 347 (Apr. 13, 1976), *codified at* 16 U.S.C. § 1852(a) (2000).

129. 16 U.S.C. § 1852(h)(1) (2000).

130. 16 U.S.C. § 1802(13)(A) (2000).

131. 16 U.S.C. § 1801(c)(3) (2000).

132. For example, a Fishery Management Council is allowed to comment on and make recommendations concerning any activity by State or Federal agencies that “may affect the habitat of a fishery resource under its jurisdiction,” and Federal agencies have to respond to the comments in writing. Fishery Conservation Amendments of 1990, Pub. L. No. 101-627, § 108(h), 104 Stat. 4436 (current version at 16 U.S.C. § 1855(b)(3), (4) (2000)). However, the Council is not required to do so unless the agency activity “is likely to substantially affect the habitat of an anadromous fishery resource under its jurisdiction.” *Compare* Fishery Conservation Amendments of 1990 § 108(h)(1)(B) (current version at 16 U.S.C. § 1855(b)(3)(B)) (Councils “shall comment”) with § 108(h)(1)(A) (current version at 16 U.S.C. § 1855(b)(3)(A)) (Councils “may comment”). This undercuts the importance of habitat considerations in fisheries management. Similarly, before 1996 FMPs had to “include *readily available* information regarding the significance of habitat to the fishery and assessment as to the effects which changes to the habitat may have upon the fishery,” Fishery Conservation Amendments of 1986, Pub. L. No. 99-659, § 105, 100 Stat. 3706 (1986), *repealed by* Sustainable Fisheries Act, Pub. L. No. 104-297, § 108(a)(3), 110 Stat. 3559 (1996) (emphasis added), but the Council need not generate its own information.

required to carry out "research on the economics of fisheries and biological research concerning the interdependence of fisheries or stocks of fish, the impact of pollution on fish populations, the impact of wetland and estuarine degradation, and other matters bearing upon the abundance and availability of fish."¹³³ Even here, however, Congress was reluctant to look beyond the fish themselves and did so only to promote the availability of more fish. Significantly missing from this research agenda is research regarding the effects of fishing on the rest of the marine environment.

In addition, in both versions of the Act Congress took a short-term view of fishery degradation. For example, the Act defines "conservation and management" to be "all of the rules, regulations, conditions, methods, and other measures (A) which are required to rebuild, restore, or maintain . . . any fishery resource and the marine environment; and (B) which are designed to assure that— . . . irreversible or long-term adverse effects on fishery resources and the marine environment are avoided . . ."¹³⁴ Thus, Congress emphasized its view that irreversible and long-term effects to fisheries had yet to occur by including consideration of the broader marine environment within fishery management and conservation.

This temporally limited, species-specific approach is an oversimplified approach to ocean management that ignores the fact that crucial information about fisheries' effect on ocean ecosystems is simply missing and fails to protect critical species of less economic interest. As the Committee on the Evaluation, Design, and Monitoring of Marine Reserves and Protected Areas in the United States has noted:

[This] species-specific approach may fail to address changes that affect productivity throughout the ecosystem. These changes may include natural fluctuations in ocean conditions (such as water temperature), nutrient over-enrichment from agricultural run-off and other types of pollution, habitat loss from coastal development and destructive fishing practices, by-catch of non-target species, and changes in composition of biological communities after removal of either a predator or prey species.¹³⁵

This approach offers no guarantees that either habitats or commercially unimportant species will be protected,¹³⁶ even though both are vital to sustaining and restoring the commercial stocks.

On a positive note, regulation is changing. For example, Congress amended the Magnuson-Stevens Act in 1996 to incorporate both a

133. Fishery Conservation Amendments of 1990, Pub. L. No. 101-627, § 110, 101 Stat. 4436 (current version at 16 U.S.C. § 1881c(c) (2000)).

134. 16 U.S.C. § 1802(5) (2000) (emphasis added).

135. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 3.

136. *Id.* at 71.

precautionary approach and “concerns about essential fish habitat, establish[ing] the framework for an ecosystem approach to management, more akin to that developed for conserving terrestrial species”¹³⁷ The amended Act allowed for the first ecosystem-based fishery management plan, the Western Pacific Coral Reef Ecosystem Fishery Management Plan.¹³⁸ Nevertheless, by continuing to focus on recent fishing pressures on commercially significant species, the amended Magnuson-Stevens Act still runs the risk of ignoring ecologically important ecosystems and species. The Committee on the Evaluation, Design, and Monitoring of Marine Reserves and Protected Areas in the United States states that:

Economic significance and ecological significance do not always coincide. Many organisms necessary for the restoration of natural ecosystem functioning may be ignored when the focus is exclusively on the few fished species. Hence, it is essential that increased attention be given to nonfished species that play important roles in marine ecosystems.¹³⁹

Moreover, conventional fisheries management strategies continue to focus on single species, and the Committee emphasizes that “[w]hether or not these single-species management strategies achieve their specific goals, their practice often neglects other important and pervasive problems.”¹⁴⁰

II.

RESTORATION OF MARINE ENVIRONMENTS AND THE OCEANS ACT OF 2000

A. *The Impetus for Change: The Oceans Act of 2000*

Together, the three aforementioned shortcomings of current U.S. ocean law and policy add up to a regulatory scheme that cannot ensure sustainable marine productivity and resources, let alone restore already-degraded marine ecosystems.¹⁴¹ In recognition of these policy deficiencies, Congress passed the Oceans Act of 2000,¹⁴² which

137. *Id.* at 74 (citing Mark A. Zacharias et al., *The British Columbia Marine Ecosystem Classification: Rationale, Development, and Verification*, 26 COASTAL MANAGEMENT 105–24 (1998)).

138. WESTERN PACIFIC FISHERY MANAGEMENT COUNCIL, FINAL FISHERY MANAGEMENT PLAN FOR CORAL REEF ECOSYSTEMS OF THE WESTERN PACIFIC, vols. I-III (Oct. 2001), available at <http://wpcouncil.org/coralreef.html>.

139. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 138.

140. *Id.* at 174. “Regulations designed for one fishery may negatively influence other species on the same fishing grounds through gear conflicts, bycatch, habitat destruction, or subtle but important shifts in predator-prey relationships.” *Id.*

141. “The deficiencies in . . . ecosystem protection cannot be overcome by continuation of ocean management on a multijurisdictional basis, in which different species are managed separately, agencies may apply regulations independently of each others [*sic*], and state and federal policies are not fully coordinated.” *Id.* at 175.

142. Oceans Act of 2000, Pub. L. No. 106–256, 114 Stat. 644.

acknowledges the need for a more integrated and comprehensive policy for managing the seas under the United States' control. The Act, which became effective in January 2001,¹⁴³ required the President to appoint a Commission on Ocean Policy to review existing laws and make recommendations for improvements.¹⁴⁴ President Bush appointed the commission in June 2001¹⁴⁵ and they first met in September 2001.¹⁴⁶ Within 18 months of its establishment—i.e., in early 2003—the Commission is scheduled to present a final report to Congress and the President.¹⁴⁷

By statutory command, the Commission's report must focus on amending existing laws and regulations and improving coordination among federal agencies and between the state and federal governments. Specifically, the report must review "the cumulative effect of Federal laws and regulations on United States ocean and coastal activities and resources," examine "those laws and regulations for inconsistencies and contradictions that might adversely affect those ocean and coastal activities and resources," "consider conflicts with State ocean and coastal management regimes," and make "recommendations for resolving such inconsistencies to the extent practicable . . ."¹⁴⁸

Although the Commission's main task thus seems to be an efficiency review, its overall purpose is to "make recommendations for a coordinated and comprehensive national ocean policy that will promote" eight substantive goals.¹⁴⁹ The resulting national ocean policy should promote "responsible stewardship, including use, of fishery resources and other ocean and coastal resources;" "the protection of the marine environment and prevention of marine pollution;" and "the enhancement of marine-related commerce and transportation . . . and the engagement of the private sector in innovative approaches for sustainable use of living marine resources and responsible use of non-living marine resources."¹⁵⁰ In addition, "[w]ithin 120 days after receiving and considering" the Commission's final report and recommendations, "the President shall submit to Congress a statement of proposals 'to implement or respond to the Commission's recommendations for a coordinated, comprehensive,

143. *Id.* § 7.

144. *Id.* § 3(a).

145. *Presidential Ocean Commission Panelists Named*, ASCRIBE NEWS, June 18, 2001.

146. U.S. Commission on Ocean Policy, *Calendar*, at

http://oceancommission.gov/calendar/cal_archive.html (last visited Oct. 8, 2002).

147. Oceans Act of 2000 § 3(f)(1). The Commission currently plans to submit its report on March 21, 2003. U.S. Commission on Ocean Policy, *Report Development Timeline 2* (May 2002), available at http://oceancommission.gov/calendar/commission_timeline.pdf.

148. Oceans Act of 2000 § 3(f)(2)(C), Pub. L. No. 106-256, 114 Stat. 644.

149. *Id.* § 2.

150. *Id.* § 2(2)-(4).

and long-range national policy for the responsible use and stewardship of ocean and coastal resources for the benefit of the United States.”¹⁵¹

As in U.S. marine regulation generally, the goals of the Oceans Act promote greater use of the oceans. For example, the Commission’s report must include “[a] review of the known and anticipated supply of, and demand for, ocean and coastal resources of the United States”¹⁵² and “[a] review of opportunities for the development of or investment in new products, technologies, or markets related to ocean and coastal activities,”¹⁵³ underscoring the traditional extractive view of ocean resources.

Nevertheless, although the Act’s goals never explicitly mention “restoration,” the Commission must address restoration issues in order to successfully promote the Act’s requirements of responsible stewardship, protection of the marine environment, and, especially, long-term sustainable use of marine resources. In addition, both the general public and the Commission on Ocean Policy have called for restoration goals in the new ocean policy. In June 2002, for example, citizens attending the Commission’s public meeting in the Pacific Northwest urged the Commission to restore the country’s degraded oceans.¹⁵⁴ More importantly, in its draft outline of elements for the recommended ocean policy, the Commission called for “[i]nvestment in ocean-based . . . environmental restoration.”¹⁵⁵

The Oceans Act, therefore, embodies a tension between increased use of the ocean’s resources and long-term sustainability and restoration. An historical perspective on the marine environment, coupled with restoration goals and more extensive use of MPAs, could resolve this tension, allowing for both restoration of marine environments and creation of more plentiful resources than will exist if current trends in regulation continue.

B. Restoration of Marine Ecosystems: The New Frontier

1. Restoration in the Terrestrial Context

Traditionally, most environmental law has emphasized “preventing future harm, ceasing or mitigating current harmful activities, and

151. *Id.* § 4(a) (emphasis added).

152. *Id.* § 3(f)(2)(D).

153. *Id.* § 3(f)(2)(F).

154. *Restore Our Damaged Oceans, Commission Urged*, ENVTL. NEWS SERVICE, June 13, 2002.

155. U.S. Commission on Ocean Policy, *DRAFT: Developing a National Policy for Our Ocean Future 2* (Apr. 17–18, 2002), available at <http://oceancommission.gov/documents/Elements.pdf>.

preserving undamaged ecosystems in a pristine state.”¹⁵⁶ Preservation, however, is giving way to a new emphasis: restoration. In a recent article entitled “The New Age of Environmental Restoration,” Professor Joseph L. Sax noted that:

The leading edge in environmental law has taken a dramatic turn in the last half-dozen years. While certain great issues remain at the forefront of global concern, in particular planetary warming and population, the focus of domestic environmental law for nearly three decades—air and water pollution, superfund cleanup, and the whole regulatory apparatus that implemented those laws—has yielded primacy to a strikingly new concern. *Its centerpiece is biodiversity; its spotlight is on restoration*, and its agenda is not directed at the individual factory, waste repository, or discharge pipe. The focus is, instead, a biologically integral unit, commonly a watershed or what is sometimes called a problem-shed.¹⁵⁷

Terrestrial ecosystems have received much legal attention in recent years,¹⁵⁸ although ecosystem awareness actually developed much earlier. In the past century, for example, governments have created terrestrial parks and reserves for a variety of esthetic and ecological reasons.¹⁵⁹ What’s really new, as Professor Sax’s article reveals, is the recent emphasis on *restoration* rather than protection of ecosystems—that is, the

156. Ludwik A. Teclaff, *Introduction*, 34 NAT. RESOURCES J. 777 (1994); see also Ludwik A. Teclaff & Eileen Teclaff, *Restoring River and Lake Basin Ecosystems*, 34 NATURAL RES. J. 905, 910 (1994) (noting that restoration “is a step further in environmental policy, beyond preservation of pristine habitat and prevention of harm”).

157. Sax, *supra* note 19, at 1 (emphasis added).

158. See, e.g., *id.* at 3–9; Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of “New Age” Environmental Protection*, 41 WASHBURN L.J. 50, 68–77 (2001); Bruce Babbitt, *Restoring Our Natural Heritage*, 14 NAT. RESOURCES & ENV’T 147, 147–49, 211 (2000); Alyson C. Flournoy, *Restoration RX: An Evaluation and Prescription*, 42 ARIZ. L. REV. 187, 189–96 (2000); Steven W. Carothers & Dorothy A. House, *Decommissioning Glen Canyon Dam: The Key to Colorado River Ecosystem Restoration and Recovery of Endangered Species?*, 42 ARIZ. L. REV. 215 (2000); C. Luther Propst & Peter W. Culp, *Searching for Cibola: Community-Based Environmental Restoration in the Colorado River Watershed*, 42 ARIZ. L. REV. 259 (2000); Charles F. Wilkinson, *A Case Study in the Intersection of Law and Science: The 1999 Report of the Committee of Scientists*, 42 ARIZ. L. REV. 307, 313–18 (2000); Joseph M. Feller & David E. Brown, *From Old-Growth Forests to Old-Growth Grasslands: Managing Rangelands for Structure and Function*, 42 ARIZ. L. REV. 319 (2000); Catherine A. O’Neill, *Restoration Affecting Native Resources: The Place of Native Ecological Science*, 42 ARIZ. L. REV. 343 (2000); Richard J. Ansson, Jr., *Protecting and Preserving Our National Parks: The Everglades National Park Restoration Project*, 19 VA. ENVTL. L.J. 121 (2000); Holly Doremus, *Restoring Endangered Species: The Importance of Being Wild*, 23 HARV. ENVTL. L. REV. 1, 4–23, 31–38 (1999); Dan Flores, *Making the West Whole Again: Historical Perspective on Restoration*, 18 J. LAND RESOURCES & ENVTL. L. 17, 24–29 (1998); Duncan T. Patten, *Restoration as the Order of the 21st Century: An Ecologist’s Perspective*, 18 J. LAND RESOURCES & ENVTL. L. 31, 33–39 (1998); Holly Doremus, *Private Property Interests, Wildlife Restoration, and Competing Visions of a Western Eden*, 18 J. LAND RESOURCES & ENVTL. L. 41, 42–50 (1998); Chad R. Gourley, *Restoration of the Lower Truckee River Ecosystem: Challenges and Opportunities*, 18 J. LAND RESOURCES & ENVTL. L. 113 (1998).

159. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 11.

movement beyond mere preservation of relatively intact ecosystems to active restoration of those that are degraded.

Restoration efforts, however, largely have been restricted to land-, lake-, and river-based ecosystems, and in these terrestrial ecosystems, restoration seeks either to recreate a prior state in the environment¹⁶⁰ or to create a new but functional, productive, and sustainable status for an ecosystem.¹⁶¹ Restoration is thus active healing rather than mere cessation of harm—the bringing back of an ecosystem to a “healthy and vigorous state.”¹⁶²

As such, restoration of terrestrial ecosystems encompasses a recognition that merely preventing additional degradation is insufficient to establish and maintain the desired level of environmental quality.¹⁶³ The change to a restorationist perspective often comes when humans begin to realize what they have lost from degradation of habitats and ecosystems,¹⁶⁴ usually as a result of prior human intervention in ecosystems. For example, numerous waterworks projects over the last

160. See Propst et al., *supra* note 158, at 278.

To restore something is to bring it back into existence, to bring it back to a prior condition. A successful act of restoration thus implies an understanding of how something was, an understanding of how it came to be different, and a deliberate choice to put it back to (or at least closer to) where one found it.

Id.

161. As several commentators have pointed out, what environmental restoration actually does is subject to several economic and ethical judgments as well as numerous criticisms of continuing human “interference.” See generally, e.g., Flournoy, *supra* note 158, at 188 (“Restoration is based in science but poses ethical questions in its application. It is intrusive but has the potential to do tremendous good. Like any therapy or remedy, it can be used appropriately and inappropriately, skillfully and ineptly, successfully and destructively.”).

162. See *id.* at 189 (relying on medical metaphors in discussing environmental restoration and preferring the health-related definition of “restore” to the more common “bring back to the original state”); see also Christopher C. Joyner, *Fragile Ecosystems: Preclusive Restoration in the Antarctic*, 34 NAT. RESOURCES J. 879, 880 (1994) (“Restoration entails a process that involves renewal and revitalization from decay to well-being; restoration enables perceptible recovery of strength and vigor from a situation of degradation and weakness. Restoration suggests renovation of an impaired ecosystem to a much improved condition, either naturally or through carefully designed, manmade strategies.”).

163. See Teclaff, *supra* note 156, at 777.

Restoration is prompted by two considerations. One is that very little of the environment worldwide is left undamaged, even on polar icesheets or the slopes of Mount Everest or in the depths of the Amazon rain forest, and that something must be done if there are to be any healthy ecosystems for future generations to enjoy. Secondly, there is a concern that merely stopping the damage is not enough, that natural processes will not by themselves bring an ecosystem back to its original state, at least not for any foreseeable future and perhaps never.

Id.

164. See, e.g., Robert E. Beck, *The Movement in the United States to Restoration and Creation of Wetlands*, 34 NAT. RESOURCES J. 781, 786 (1994) (tracing changes in attitudes about wetlands to “the understanding not only about the loss of waterfowl habitat but about the many other purposes that wetlands serve”).

two centuries “have nearly obliterated some aquatic ecosystems. For these ecosystems nothing short of restoration will help.”¹⁶⁵ Proponents of restoration often seek to put the human and the non-human into a state of balance: Restoration “means restoring the possibility of coexistence between [an ecosystem’s] non-human and human elements and its potential for sustainable, multipurpose use.”¹⁶⁶

2. *Active Restoration of Marine Ecosystems: The Ocean’s Advantages and Disadvantages*

Restoration of marine ecosystems is a much newer endeavor than restoration of terrestrial ecosystems,¹⁶⁷ and even on land, restoration often poses many difficulties. First, “certain areas are easier to restore than others and certain functions or values are easier to restore than others.”¹⁶⁸ Second, human knowledge about any ecosystem is imperfect, creating the distinct possibility that restoration efforts will fail. This difficulty is multiplied several-fold for marine ecosystems, where scientific and ecological research lags far behind that on land.

Nevertheless, some marine ecosystems are so important to humans and so badly degraded that active restoration has been attempted. Prime examples include coastal wetlands and estuaries. Approximately “20,000 acres of coastal wetlands are disappearing each year,”¹⁶⁹ and many coastal wetlands and estuaries that remain are degraded. Thanks in part to the Clean Water Act,¹⁷⁰ active wetlands restoration, for both freshwater and coastal wetlands, has a relatively long history in the United States. Such restoration often consists of rebuilding destroyed wetlands or creating “substitute” wetlands from scratch,¹⁷¹ and coastal wetland restoration has a much higher success rate than freshwater wetland restoration,

165. Teclaff & Teclaff, *supra* note 156, at 906.

166. *Id.*

167. See AGARDY, *supra* note 4, at 11.

While most nation states have signaled their interest in protecting while sustainably using their terrestrial ecosystems, as witnessed by numerous international agreements from the Earth Summit to the Convention on Biological Diversity, the same degree of awareness and commitment to conservation has not been afforded coastal and ocean areas under their national jurisdictions.

Id.

168. Beck, *supra* note 164, at 799.

169. S. REP. NO. 106-301, at 6 (2000), available at http://oceancommission.gov/documents/Senate_Report.pdf.

170. See 33 U.S.C. § 1344 (2000) (requiring permits for the discharge of dredged or fill material into the navigable waters); 33 C.F.R. § 328.3(a)(3) (2001) (defining “waters of the United States” for permit purposes to include wetlands); 40 C.F.R. § 230.41 (2001) (EPA’s guidance for such permits, seeking to prevent the degradation of wetlands); see also Beck, *supra* note 164, at 786-87 (describing the Clean Water Act’s relationship to wetlands).

171. See Beck, *supra* note 164, at 798-99 (describing the different kinds of wetlands restoration and the goals therein).

suggesting that marine restoration efforts have some advantages over terrestrial. For instance, “[a] Florida study shows an overall survival rate of . . . only 12 percent for freshwater [created wetland] sites,” while wetlands overall have a 27 percent survival rate.¹⁷²

Other types of active marine restoration are possible, such as re-introduction of locally extirpated species. Similar attempts on land can be stymied by the extinction of key species, but most key marine species survive despite drastically depleted numbers, allowing for their possible reintroduction into degraded ecosystems.¹⁷³ For example, in 2001, scientists at the University of Miami raised black sea urchins in the lab. They then released lab-raised urchins onto the coral reefs in the Florida Keys, where a 1983 disease epidemic had wiped out the natural stock and allowed algae to grow up and smother the coral.¹⁷⁴ On the other side of the country, the California Coastal Commission recently approved plans to plant giant kelp in two southern California locations in an attempt to restore the kelp forests that used to grow there.¹⁷⁵

Marine habitat rebuilding is another kind of active restoration. As on land, such rebuilding can take two forms. First, marine habitat rebuilding, especially in the coastal zone, can involve the undoing of prior human changes. For example, a century ago bird hunters sealed off wetlands just inland of Bolsa Chica State Beach in southern California, preventing direct contact between those wetlands and the sea.¹⁷⁶ The result was stagnation and pollution of the wetlands.¹⁷⁷ California decided to restore those wetlands “to their natural state” in late 2001, and its restoration involved digging a channel to reconnect the wetlands and the ocean, a project that will cost \$100 million.¹⁷⁸ The State hopes to restore 1200 acres of polluted salt marshes into “a flourishing ecosystem of rare flora and fauna.”¹⁷⁹

The second type of marine habitat rebuilding creates new habitat where the natural habitat has been completely destroyed. For example, various coral reef restoration efforts have used “reef balls”—described as “dome-shaped concrete structures filled with holes”—to create artificial

172. *Id.* at 799 (citing Ann Redmond, *How Successful Is Mitigation?*, NAT'L WETLANDS NEWSL., Jan.-Feb. 1992, at 5).

173. “Human-induced extinctions in the marine environment have lagged behind those of terrestrial ecosystems, so there still exists the biological potential with which to rebuild coastal marine ecosystems.” Charles Peterson et al., *Factors in the Decline of Coastal Ecosystems: Response*, 293 SCIENCE 1590 (Aug. 31, 2001).

174. John Carey, *Save an Urchin, Restore a Reef?*, BUS. WK., Aug. 13, 2001, at 73.

175. Seema Mehta, *Ocean to Get Kelp from Its Friends*, LOS ANGELES TIMES, Apr. 10, 2002, at B6.

176. Seema Mehta, *Orange County Panel OKs Bolsa Chica Restoration*, LOS ANGELES TIMES, Nov. 14, 2001, at B1.

177. *Id.*

178. *Id.*

179. *Id.*

reefs, “restoring marine life where natural reefs have been damaged or creating a reef where none previously existed.”¹⁸⁰ Such efforts are helping to revive ivory tree coral ecosystems off the coast of Florida.¹⁸¹

The Chesapeake Bay restoration effort is one of the largest coastal restoration projects undertaken to date, and it combines many of these active restoration methods. The Bay has suffered severe degradation for almost a century as a result of overfishing and disease.

Overfishing in the late 19th and early 20th centuries reduced the bay’s oyster harvest from a peak of about 24 million bushels in 1887 to about 5 million by 1930. Two diseases, Dermo and MSX, further devastated oyster populations in the 1980s, so that today they exist at approximately 1 percent of their historic levels.¹⁸²

The declines in oyster populations directly affect the bay’s water quality. At their peak historic levels, the oysters “in the late 1800s could have filtered the entire water column in just three days. Today’s population would take over a year to accomplish the same feat”¹⁸³ As a result, Chesapeake Bay suffers not only from severely reduced oyster harvests but also from increasing pollution.¹⁸⁴

The Chesapeake Bay states—Virginia, Maryland, and Pennsylvania—formed coalitions in the early 1980s to clean up and to restore the bay.¹⁸⁵ These efforts gained momentum in 1998, when the EPA listed the bay as an impaired waterbody under the Clean Water Act¹⁸⁶ and urged Virginia to come up with a plan to get it back *off* the list.¹⁸⁷ In 2000, Virginia, Maryland, Pennsylvania, EPA, and the Chesapeake Bay Commission signed an ambitious agreement to restore Chesapeake Bay by 2010.¹⁸⁸

Chesapeake Bay restoration includes active habitat restoration. The plan specifically requires restoration of 25,000 acres of wetlands.¹⁸⁹ In addition, to meet oyster restoration goals, Virginia must restore approximately 1,500 acres of oyster grounds, over a ten-year period,

180. Kandace Lankford, *Reef Balls Restore Marine Life*, FLA. TIMES-UNION, Aug. 22, 2001, at 1.

181. NOAA, *Experimental Oculina Research Reserve*, at http://mpa.gov/mpadescriptive/cs_obrr.html (last updated Apr. 5, 2002).

182. Anita Huslin, *Depleted Oyster Beds Being Restored in Chesapeake Bay*, PITTSBURGH POST-GAZETTE, July 22, 2000, at A2.

183. Stephen Manning, *Chesapeake Oyster Beds Restored*, AP NEWSWIRE (April 14, 2002).

184. Jeff Long, *Virginia, Other States to Sign Agreement to Restore, Protect Chesapeake Bay*, KNIGHT-RIDDER TRIB. BUS. NEWS, June 28, 2000.

185. *Id.*

186. *Id.*; see also 33 U.S.C. § 1313(d)(1) (2000) (requiring states to identify and list waters that do not meet the state-designated water quality standards).

187. See 33 U.S.C. § 1313(d) (2000) (requiring states to set total maximum daily loads (TMDLs) and to engage in continuing planning for water quality impaired water bodies).

188. Long, *supra* note 184.

189. *Id.*

which is expected to cost at least \$30 million.¹⁹⁰ State efforts to restore the oysters include the creation of artificial oyster reefs. Virginia began building these reefs in 1993 and had completed 28 of them by 2000.¹⁹¹

Successful restoration of the Chesapeake Bay ecosystem also requires the reintroduction of several species. The 2000 plan calls for increasing the number of oysters in the bay tenfold by 2010,¹⁹² and most oyster reintroduction is being done through direct governmental efforts. However, the Chesapeake Bay coalition also has created an "oyster gardening" program, where private residents along the bay raise oysters in the waters near their homes.¹⁹³ In 1997, trumpeter swans were trained to follow an ultralight plane in an attempt to reintroduce them into the bay.¹⁹⁴ In late 2001, the coalition finalized plans to reintroduce the severely overfished Atlantic sturgeon into the Bay, because 1996 studies showed that pre-migratory sturgeon could safely mature in the Bay and that migratory sturgeon could continue to forage there during some parts of the year.¹⁹⁵ Reintroduction will be accomplished through a captive breeding program, drawing on stocks of Atlantic sturgeon in the Hudson River system.¹⁹⁶

While time will tell how successful the Chesapeake Bay project will be, active restoration of marine ecosystems in general has enjoyed only limited success. For example, although actively restored marine wetlands and estuaries are more likely to succeed than restored freshwater wetlands, only about 27% of all wetland restoration is successful¹⁹⁷—not an encouraging statistic. Similarly, artificial reefs have enjoyed only limited success:

[A]rtificial reefs placed on previously unstructured seabed and then protected from fisheries likely do not substitute for protecting natural ecosystems because functional biological communities also depend on the local oceanographic and environmental conditions and long-term interactions among species. Hence, artificial reefs may have little impact on overall productivity of reef fish populations and may in effect increase pressure on populations occurring at natural sites.¹⁹⁸

190. Scott Harper, *Chesapeake Bay Oyster Restoration Project Hits Snag*, KNIGHT-RIDDER TRIB. BUS. NEWS, Dec. 20, 2000.

191. *Id.*

192. Long, *supra* note 184.

193. Manning, *supra* note 183.

194. D'Vera Cohn, *Swans Take Off for the Eastern Shore*, WASHINGTON POST, Dec. 19, 1997, at C1.

195. James D. Martin, *Project to Help Restore Atlantic Sturgeon to Chesapeake Bay*, FEEDSTUFFS, Dec. 31, 2001, at 15.

196. *Id.*

197. Beck, *supra* note 164, at 799 (citing Ann Redmond, *How Successful Is Mitigation?*, NAT'L WETLANDS NEWSL., Jan.-Feb. 1992, at 5).

198. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 74.

Marine habitat restoration can encounter unexpected problems as well. In Chesapeake Bay, for example, artificial reef building efforts were hampered in 2000 because of a shortage of oyster shells to rebuild the reefs.¹⁹⁹

In addition, several features of marine ecosystems make active restoration unpredictable, particularly as regards reintroduction of species. Unlike many terrestrial ecosystems, marine ecosystems often lack definable geographical boundaries, and many marine organisms disperse on the currents at various stages of their lives.²⁰⁰ For example, many important marine species start life as tiny plankton, drifting with the ocean currents until they become large enough to settle into more fixed homes. As a result, the "habitat" necessary to restore a single organism may be geographically enormous, challenging both scientific understanding and regulatory jurisdiction.²⁰¹ In addition, marine ecosystems constantly change and move; seasonal upwellings and daily surfacings and sinkings make them truly three-dimensional. In contrast, "land-based systems are predominantly two-dimensional, with most ecological communities 'rooted' to the two-dimensional plane that is the earth's surface."²⁰² Restoring marine ecosystems thus requires an additional level of conceptualization, description, and protection than most terrestrial ecosystems.²⁰³

Marine ecosystems also may be more variable than terrestrial ecosystems, especially on shorter time scales. Marine ecosystems are subject to the physics of the surrounding medium and respond to forces such as tides, circulation patterns, and decadal shifts in overall productivity, whereas terrestrial ecosystems are more internally controlled by the life processes of the dominant organisms (e.g., trees) and may change only slowly, sometimes on century time scales, unless humans intervene²⁰⁴

199. Harper, *supra* note 190.

200. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 18-19 (citing J.H. Steele, *Regime shifts in fisheries management*, 25 FISHERIES RESEARCH 19 (1996); J.H. Steele, *Marine ecosystem dynamics: Comparison of scales*, 6 ECOLOGICAL RESEARCH 175 (1991); J. H. Steele, *A comparison of terrestrial and marine ecological systems*, 313 NATURE 355 (1985)); *see also* AGARDY, *supra* note 4, at 15 (noting that "marine and coastal systems have nebulous boundaries").

201. AGARDY, *supra* note 4, at ii.

202. *Id.* at 14.

203. *See* MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 119-20 (discussing vertical zoning for fishing over sea mounts).

204. *Id.* at 17-18 (citing J.H. Steele, *Regime Shifts In Fisheries Management*, 25 FISHERIES RESEARCH 19 (1996); J.H. Steele, *Marine Ecosystem Dynamics: Comparison Of Scales*, 6 ECOLOGICAL RESEARCH 175 (1991); J. H. Steele, *A Comparison Of Terrestrial And Marine Ecological Systems*, 313 NATURE 355 (1985)).

Because of such variability, marine environments can change drastically and quickly.²⁰⁵ Moreover, the physical processes driving marine ecosystems are “largely changeable and unpredictable . . . to a much greater extent than on land,” making it difficult to control the effects of active management.²⁰⁶ As a result, active restoration efforts run the risk of producing immediate and unexpected effects or of producing initial benefits but no long-term security against future perturbations.

Given these limitations, active restoration is unlikely to play a major role in marine restoration efforts in the near future. Instead, marine restoration will need to rely on passive restoration methods such as MPAs.

3. *Passive Restoration of Marine Ecosystems: MPAs and Fishing-Related Degradation*

Restoring marine ecosystems is significantly different from restoring terrestrial ecosystems, both scientifically and socio-politically.²⁰⁷ The most important difference is that restoration of marine ecosystems often can be accomplished simply by leaving them alone. In terrestrial ecosystems, humans have wrought major structural changes that directly and indirectly affect ecosystem function—the conversion of habitat to farms and subdivisions, the leveling of forests, the damming of rivers, the diversion of water for irrigation, and so on. In these cases, merely leaving the altered ecosystems alone will do nothing to restore the original ecosystem. Forests take considerable time to grow back to pre-harvest function, pavement takes decades to wear away, and dams will continue to block the flow of water regardless of human inaction.

a. *Ecosystem Damage Produced by Overfishing*

While many anthropogenic activities stress marine ecosystems, particularly in the coastal zone,²⁰⁸ many scientists cite overfishing and

205. *Id.* at 15.

206. *Id.* at 16.

207. *See id.* at 17 (“Differences in approaches to the conservation of marine and terrestrial areas reflect both (1) differences in ecosystem processes and (2) differences in historical perceptions and regulatory frameworks.”); *see also* AGARDY, *supra* note 4, at 14.

Marine and terrestrial systems exhibit differences in scale and process and thus require somewhat different paradigms for conservation and resource management. This dichotomy in management approaches can be traced to two factors: 1) the actual nature of marine and coastal systems differs markedly from that of the land . . . and 2) our perception of ocean and land spaces is fundamentally disparate.

Id. (citation omitted).

208. Robin Kundis Craig, *Sustaining the Unknown Seas: Changes in U.S. Ocean Policy and Regulation Since Rio '92*, 30 ENVTL. L. REP. 10,190, 10,195–200 (Feb. 2002).

related extractive uses as the leading causes of ecological disturbance.²⁰⁹ The Chesapeake Bay concretely demonstrates how fishing, especially commercial fishing, can have devastating cumulative impacts on both species and ecosystems.²¹⁰ The equipment used in commercial fishing disturbs vegetation, such as sea grass, and other habitats.²¹¹ Overfishing leads to reduction in fish size and population and also affects prey and predator populations.²¹² Targeted fishing also results in bycatch, where fishers catch non-target species that generally have behavior or habitat similarities.²¹³ As Kate Wing explains in her monograph, *Keeping Oceans Wild*, overfishing “can completely eliminate a level of the food chain and shift the dynamics of the entire system. Where once there were schools of large predatory fish, now there may only be tiny fish feeding on plankton.”²¹⁴ Thus, overfishing affects the particular fish stocks as well as other organisms, “ecological processes, and even entire ecosystems that are critical to the oceans’ overall health.”²¹⁵

Overfishing further damages marine habitat by triggering a phenomenon known as “fishing down the food web.”²¹⁶ Often, fishers in a given ecosystem target the large predatory fish at the top of that ecosystem—cod, tuna, and similar species. As those stocks become depleted, however, fishers shift to species lower down the food chain—species previously thought of as “trash fish.” Kate Wing provides one example of many:

209. CALLUM M. ROBERTS & JULIE P. HAWKINS, FULLY PROTECTED MARINE RESERVES: A GUIDE (2000), available at http://www.panda.org/resources/publications/water/mpreserves/mar_index.htm; OSHA GRAY DAVIDSON, *supra* note 1, at 74–90; MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 2.

210. “Over two-thirds of the world’s commercially fished stocks are overfished or at their sustainable limits, according to Food and Agricultural Organization statistics.” Tundi Agardy, *Creating Havens for Marine Life*, 16 ISSUES IN SCI. AND TECHNOLOGY ONLINE 1, 3 (1999), available at <http://www.nap.edu/issues.16.1/agardy.htm>.

211. KATE WING, KEEPING OCEANS WILD: HOW MARINE RESERVES PROTECT OUR LIVING SEAS 2–3 (Apr. 2001) (citing S.F. Thrush et al., *Disturbance Of The Marine Benthic Habitat By Commercial Fishing: Impacts At The Scale Of The Fishery*, 8 ECOLOGICAL APPLICATIONS 866 (1998); David R. Lindberg et al., *Human Influences On Trophic Cascades Along Rocky Shores*, 8 ECOLOGICAL APPLICATIONS 880 (1998)).

212. *Id.*

213. *Id.* at 3.

214. *Id.* at 3 (citing S.F. Thrush et al., *supra* note 211; David R. Lindberg et al., *supra* note 211).

215. Agardy, *supra* note 210, at 3.

216. See WING, *supra* note 211, at 3 (citing Daniel Pauly et al., *Fishing Down Marine Food Webs*, 279 SCI. MAG. 860 (1998)); see also Robert J. Wilder, Mia J. Tegner, & Paul K. Dayton, *Saving Marine Biodiversity*, 15 ISSUES IN SCI. & TECHNOLOGY ONLINE 1, 3–4 (1999), available at <http://www.nap.edu/issues/15.3/wilder.htm> (describing the practice in similar terms and referring to fishing down the food chain as one of the worst of the “egregious practices” that should be eliminated in order to protect marine biodiversity).

[B]y the end of the 1900s, centuries of heavy cod fishing in New England led to an increase in many species that cod like to eat, such as sea urchins, herring, and mackerel. As cod stocks began crashing, fishermen shifted to the herbivorous sea urchins—the next species down the food chain. Other former cod fishermen moved on to herring and mackerel, species that are key prey not just for cod but also for marine mammals. The spiny dogfish, formerly considered a “trash” fish with no value, had its image rehabilitated for the market once it was one of the few species left. Now it, too, is over fished. While marketing and consumer demand can dictate what fishermen will be able to sell, it is the ecology of the system that determines what will be alive to be caught.²¹⁷

“Fishing down the food chain” is an unsustainable practice that, especially in combination with other ocean stressors like pollution and global climate change, could lead to ocean ecosystem collapse.²¹⁸

Fishing can thus destroy a marine ecosystem. Kate Wing projects that, once destroyed, “it may take fifty to one hundred years for a population of fish to recover to even half its initial size.”²¹⁹ Moreover, centuries of overfishing have contributed to a “shifting baseline syndrome” regarding ocean productivity.

Because fishery managers rarely have a chance to look back more than a decade or two, gradual changes slip by unnoticed until the tiny fish thrown back yesterday become today’s biggest prizes. It is not always possible to reconstruct old data sets, and without a historic frame of reference it is easy to believe that today’s conditions are the way things have always been.²²⁰

b. Impetus for Marine Restoration

Growing awareness of the consequences of overfishing drives both the interest in and goals for marine restoration. Specifically, declines in commercially valuable species—for example, the oysters, sturgeon, and blue crabs in Chesapeake Bay²²¹—from overfishing often prompt marine restoration efforts. However, when “outside” groups—often recreation and environmental organizations—attempt to limit fishing, they inevitably trigger opposition from powerful fishing lobbies. Therefore,

217. WING, *supra* note 211, at 3 (citing MARK KURLANSKY, *COD: A BIOGRAPHY OF THE FISH THAT CHANGED THE WORLD* (1997); Robert S. Steneck, *Fisheries-Induced Biological Changes To The Structure And Function Of The Gulf Of Maine Ecosystem*, in *GULF OF MAINE ECOSYSTEM DYNAMICS SCIENTIFIC SYMPOSIUM AND WORKSHOP 153–65* (1996)).

218. *Id.*

219. WING, *supra* note 211, at 3.

220. *Id.* at 4.

221. See Huslin, *supra* note 182, at A2; Martin, *supra* note 195, at 15; Scott Harper, *Efforts to Restore Chesapeake Bay’s Blue Crabs Mired in Politics*, KNIGHT-RIDDER TRIB. BUS. NEWS, July 17, 2000.

marine restoration efforts must, of political necessity, continue to accommodate uses such as fishing that are directly exploitative of marine species. By comparison, terrestrial restoration usually focuses on providing previously ignored species with space and habitat. For example, Professor Sax and others have argued that terrestrial restoration efforts have largely been driven by the Endangered Species Act and its preservationist goal of absolutely reducing the take of endangered and threatened species.²²² In contrast, marine restoration will be driven, at least in part, by a goal of repopulating currently overfished species and overused ecosystems exactly *so that they may continue to be taken and used*. The tension within the Oceans Act, in other words, is the general tension between the need for marine restoration and the political limits upon it.

c. Marine Protected Areas as Regulatory Tools

Several studies indicate that leaving areas of the marine environment alone—what I have termed passive restoration—can restore both fished and unfished species. The best regulatory tool for doing so is the marine protected area (“MPA”). MPAs “target a location, not a single activity or species.”²²³ They are the marine equivalent of national parks and wilderness areas.²²⁴ As such, MPAs protect the marine environment on an ecosystem basis, protecting not just individual species and resources but also their habitats and their interdependence.²²⁵

MPAs are an inherently flexible management tool. MPAs can vary in size and allowable uses to meet the particular restoration goals for a marine ecosystem, whether those goals are to increase stock productivity for fishing or to protect critical or endangered habitats.²²⁶ In addition, marine reserves—the most protective type of MPA—may be the only way to preserve relatively undegraded marine ecosystems, which can then serve as baselines for measuring progress in restoring degraded ecosystems.²²⁷

222. See, e.g., Sax, *supra* note 19, at 1–3 (arguing that the Endangered Species Act has been “[t]he most significant catalyst” for moving environmental law to a restoration and biodiversity focus); Carothers et al., *supra* note 158, at 215, 218 (emphasizing “the power of the Endangered Species Act of 1973 (‘ESA’) to shape natural resource management actions”).

223. WING, *supra* note 211, at 5.

224. See MPAs: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 11, 17 (comparing MPAs and terrestrial protected areas).

225. *Id.* at 17, 73.

226. MPAs: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 13–14. “Although MPAs will require different design features than terrestrial protected areas, the motivations for creating them are similar and include maintaining essential ecological processes, preserving biological diversity, ensuring the sustainable use of species and ecosystems, and protecting cultural heritage sites.” *Id.* at 17.

227. *Id.* at 27.

MPAs use marine zoning to accomplish multiple use regulation. "Much like zoning on land, different MPAs allow and prohibit different actions, ranging from those where conservation is most important to sites where any type of use is allowed."²²⁸ The most protective marine zones, referred to as marine reserves, forbid all activities, except perhaps limited scientific research,²²⁹ to protect critical areas—perhaps a spawning site or habitat for juveniles of the species. Slightly less protective marine reserves allow diving, snorkeling, and moored boating but prohibit all extractive uses and boat anchoring.²³⁰ Non-reserve zones allow various kinds of fishing, collecting, and other extractive uses. Several zones can exist within a single MPA, and well-chosen, scientifically based combinations of different zones can contribute to the strength of MPAs "in protecting the biodiversity of a location, rather than trying to address each individual human impact separately."²³¹

Both MPAs and marine reserves can restore species and habitats harmed by overfishing. In general, MPAs serve two fisheries-related goals. First, an MPA can act "as an 'insurance policy' against overfishing an entire stock,"²³² protecting a subset of fish from complete annihilation. Second, MPAs can "contribute to and augment the fishery."²³³ Scientists hypothesize that such augmentation can occur in two ways—either the fish themselves swim out of the MPA, or fish export larvae to the surrounding waters.²³⁴ There is now significant agreement that marine reserves in particular are vital management tools for preserving and restoring fisheries.²³⁵ Marine reserves promote healthy habitats for fish,²³⁶ create havens where fish cannot be caught,²³⁷ and give individual members of overfished species a chance to grow to large size, increasing

228. WING, *supra* note 211, at 4.

229. MPAs: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 1; *see also* NRDC, Index: KEEPING OCEANS WILD: HOW MARINE RESERVES PROTECT OUR LIVING SEAS (Apr. 2001), available at <http://www.nrdc.org/water/oceans/kow/kowinx.asp> ("Marine reserves are based on the simple idea of leaving parts of the sea undisturbed."); Agardy, *supra* note 210, at 2 ("'Harvest refugia' or 'no-take zones' are small areas closed to fisheries extraction, designed to protect a particular stock or suite of species (usually fish or shellfish) from overexploitation.").

230. NRDC, *supra* note 229.

231. WING, *supra* note 211, at 5.

232. *Id.*

233. *Id.*

234. *Id.* at 5–6 (citations omitted); *see also* WWF, *Fully Protected Marine Reserves in a Nutshell*, available at

http://www.panda.org/resources/publications/water/mpreserves/mar_fully.htm (last visited Feb. 15, 2002) ("Many of the eggs and larvae produced by fish in fully-protected reserves will drift into fishing grounds and help restock the fishery.").

235. WWF, *supra* note 234.

236. WING, *supra* note 211, at 8.

237. *Id.*

the reproductive capacity of the species.²³⁸ Overall, studies conclude that “reserves harbor more fish, larger fish, and healthier habitat than are found outside of protected areas.”²³⁹ Specifically, “[o]n average, marine reserves have twice as many fish overall and three times as many large fish as in exploited areas.”²⁴⁰ Marine reserves also “often increase population densities,” improving the chances of reproductive success for certain marine species, especially “those that are attached to the bottom or have limited powers of movement (e.g., oysters, clams or abalones)”²⁴¹ The result is not only increased productivity within the reserve itself but also a “spillover effect” into the surrounding fishing grounds.²⁴²

Because MPAs and marine reserves are flexible marine management tools, they also lend themselves to more general goals—such as restoring biodiversity and habitat—than the myopic focus on restoring particular species of fish.²⁴³ Marine biodiversity exists on “three discrete levels: ecosystems and habitat diversity, species diversity, and genetic diversity (differences among and within populations).”²⁴⁴ Through careful, scientifically-based use of zoning, MPAs can protect and restore all three levels. In the Galápagos Marine Reserve, staff have utilized this concept to construct a zoning scheme “that will represent all habitats and biogeographic regions of the archipelago in the two categories of no-take zone,” not only protecting habitat and biodiversity but also spreading the fishing benefits throughout the area.²⁴⁵

The Chesapeake Bay restoration efforts demonstrate the usefulness of MPAs and marine reserves in restoring overfished ecosystems. Although numerous active efforts are being employed to restore the bay,

238. WWF, *supra* note 234, ¶ 1; see also NRDC, *Announcement: Keeping Oceans Wild: Marine Reserves Are Like National Parks, and They Are Critical to Keeping the World's Oceans Healthy and Productive*, at <http://www.nrdc.org/water/oceans/mpa.asp> (last revised Apr. 26, 2001). Specifically:

The ability of reserves to shelter large fish is particularly critical to the ecosystem. As fish grow larger, their ability to produce eggs increases exponentially so that in terms of making new fish, one big fish can equal nearly 100 smaller fish. Particularly in very long-lived species such as Pacific rockfish, large individuals (over 20 years old) produce the majority of eggs for the entire population of fish.

WING, *supra* note 211, at 19 (citing Marty L. Gingras et al., *First Observations Of A Vermillion Rockfish Courtship Are From A Harvest Refuge*, 84 CAL. FISH & GAME 176 (1998)).

239. NRDC, *supra* note 238; see also Agardy, *supra* note 210, at 1 (summarizing research from marine reserves around the world).

240. NRDC, *supra* note 238; see also WING, *supra* note 211, at 19 (using the same language).

241. WWF, *supra* note 234, ¶ 2.

242. *Id.*; see also NRDC, *supra* note 238; Agardy, *supra* note 210, at 4.

243. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 177.

244. Wilder et al., *supra* note 216, at 2.

245. WWF, *The Galápagos Marine Reserve, Ecuador, at*

http://www.panda.org/resources/publications/water/mpreserves/mar_gala.htm (last visited Nov. 10, 2002).

the coalition has determined that MPAs and marine reserves should also be used to achieve its restoration goals. For example, despite political controversy, in December 2000 Virginia approved a 465-square-mile no-harvest zone for blue crab “to allow 1 million more pregnant females to reach vital spawning grounds off Virginia Beach and Norfolk.”²⁴⁶ In 1993 Maryland and Virginia decided to establish 10% of the oyster beds as oyster sanctuaries, where harvesting is prohibited so that “oyster populations can proliferate and provide shelter and food for crabs, fish and other aquatic life.”²⁴⁷

4. *The Need for Scientifically-Based Goals in Marine Restoration*

Like terrestrial restoration efforts, marine restoration efforts need both ecologically accurate descriptions of how the ecosystem has functioned in the past and goals in order to define what a successful restoration is.²⁴⁸ These two needs generally are not identical, especially when the ecosystem in the past was relatively free of anthropogenic stresses and changes. Restoration advocates agree that “bringing land back to its ‘original state’ when restoring natural systems is neither possible, nor desirable.”²⁴⁹ In terrestrial ecosystems, defining a restoration goal more often involves determining what levels of human influence are “acceptable” and what level of restoration is even possible, given intervening extinctions of key species, rather than discovering what the “natural” ecosystem looked like.²⁵⁰ Professor Sax agrees, writing that in freshwater aquatic restoration projects,

246. Harper, *supra* note 221.

247. *Id.*

248. See, e.g., Sax, *supra* note 19, at 10 (“Another fundamental question raised by the effort to forge a new balance between developmental and ecosystemic values is what will count as success? The goal, after all, is some measure of restoration of biological services . . .”).

249. Flournoy, *supra* note 158, at 189 (citing Laura L. Jackson et al., *Ecological Restoration: A Definition and Comments*, 3 RESTORATION ECOLOGY 71, 73 (1995); Richard J. Hobbs & David A. Norton, *Towards a Conceptual Framework for Restoration Ecology*, 4 RESTORATION ECOLOGY 93, 98 (1996); Bruce P. Van Haveren et al., *Restoring the Ecological Integrity of Public Lands*, 52 J. SOIL & WATER CONSERVATION 226 (1997); Frederick Turner, *The Invented Landscape*, in BEYOND PRESERVATION: RESTORING AND INVENTING LANDSCAPES 35, 38–39 (A. Dwight Baldwin, Jr. et al. eds., 1994)).

250. *Id.* at 195.

We cannot simply go back, identify, and then recreate some mythic ideal state of a given natural system. When we decide to undertake restoration, we must judge what attributes of the ecosystem to restore and then identify the processes and functions that would enable the ecosystem to continue to evolve with those attributes.

Id. (citing Jackson et al., *supra* note 249, at 72; Hobbs & Norton, *supra* note 249, at 101–02; V. Thomas Parker, *The Scale of Successional Models & Restoration Objectives*, 5 RESTORATION ECOLOGY 301, 304–05 (1997)); see also David L. Wegner, *Looking Toward the Future: The Time Has Come to Restore Glen Canyon*, 42 ARIZ. L. REV. 239, 257 (2000) (noting that “[w]e cannot replace the ecosystem that existed before the dam. What we can restore are the natural processes that define and sustain a river and biological system.”).

the focus for management is habitat needs for the protection and restoration of biodiversity, *measured not by some ideal pre-European settlement standard*, but by an achievable level that looks to recovery of indigenous species like salmon at sustainable levels, while maintaining a prosperous agricultural economy and accommodating not only existing levels of population, but substantial anticipated growth.²⁵¹

The disjunction between past ecosystem functions and the restoration goals actually pursued for the future is more difficult to ascertain in marine ecosystems. Ocean ecosystems, past and present, are far less well understood than terrestrial ecosystems and far more difficult for both the general public and government regulators to imagine than land areas such as Yellowstone National Park, or even the relatively pristine areas of Alaska. As the Committee on the Evaluation, Design, and Monitoring of Marine Reserves and Protected Areas in the United States has noted, "Marine ecosystems are highly variable associations as a result of both natural variation and anthropogenic effects," but "it is extremely difficult to discern natural from human-induced causes . . ."²⁵² Nevertheless, "[u]nderstanding the influence of humans' actions on marine systems is critical to evaluating the need for and effectiveness of management actions . . ."²⁵³ The lack of such information will hinder any attempts to establish rational goals for restoring marine ecosystems and will likely lead regulators to settle for "restoring" marine ecosystems to the status of less than a century ago, after large-scale mechanized fishing became the norm.

Scientific studies that allow for new, broader visions of marine ecosystem productivity thus are as important for marine restoration as studies that more minutely explain the current functioning and interconnections of those ecosystems. As Alyson Flournoy has argued, "Whatever the limits of our knowledge, we need to avail ourselves of the best information possible in undertaking restoration. An essential but often overlooked initial step in restoration is to '[i]dentify processes leading to degradation.'"²⁵⁴ Historical overfishing is one such process that has degraded marine ecosystems, according to Jeremy B.C. Jackson's historical review of marine ecosystems. Awareness of this historical perspective should inform any goals that the United States sets for marine restoration.

251. Sax, *supra* note 19, at 7 (emphasis added).

252. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 27.

253. *Id.* at 78.

254. Flournoy, *supra* note 158, at 192 (quoting Hobbs & Norton, *supra* note 249, at 95).

B. *The Deep View of Marine Restoration: The Historical Effects of Overfishing on Marine Ecosystems*

Modern commercial overfishing is often cited as the primary cause of marine ecosystem degradation.²⁵⁵ Less widely emphasized, however, is the long history of human overfishing—and the ecological effects that both current and historical human overfishing have had on nontarget species and entire marine ecosystems.

Humans have been fishing the oceans—and affecting marine ecosystems—for millennia.²⁵⁶

In North America, coastal areas have been affected by human activities starting with the migration of people across the Bering Sea land bridge and colonization of the West Coast more than 10,000 years ago. When Europeans arrived in the Americas, they encountered marine ecosystems already shaped by human influence. Human exploitation of marine resources changes the structure of ecosystems through impacts on the food web and habitat.²⁵⁷

The human role has not been trivial. Human efficiency in capturing fish has led to fishing at unsustainable levels, prompting the observation that “the human role in the ecosystem may be considered analogous to that of a keystone predator.”²⁵⁸

According to Jeremy B.C. Jackson of the Scripps Institute of Oceanography and a host of colleagues, humans have so drastically altered marine environments throughout the world for so long that we can scarcely imagine “restored” ecosystems.²⁵⁹ In July 2001, a few weeks after President Bush appointed the Commission on Ocean Policy, these scientists published an historical analysis of human effects on the marine environment, analyzing four categories of historical evidence:

Paleological records from marine sediments from about 125,000 years ago to the present, coinciding with the rise of modern *Homo sapiens*.

Archaeological records from human coastal settlements occupied after about 10,000 years before the present (yr B.P.) when worldwide sea level approached present levels. These document human exploitation of coastal resources for food and materials by past populations that range from small-scale aboriginal societies to towns, cities, and empires.

255. See *supra* note 209 and accompanying text.

256. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 43 (citing Zacharias et al., *supra* note 137.)

257. *Id.*

258. *Id.* at 31, 43 (citing J.C. Castilla, *Humans: Capstone Strong Actors In The Past And Present Coastal Ecology Play*, in M.I. McDonnell & S.T.A. Pickett (eds.), HUMAN AS COMPONENTS OF ECOSYSTEMS 158–62 (1993)).

259. Jackson et al., *supra* note 37, at 629, 636.

Historical records from documents, journals, and charts from the fifteenth century to the present that document the period from the first European trade-based colonial expansion and exploitation in the Americas and the South Pacific.

Ecological records from the scientific literature over the past century to the present covering the period of globalized exploitation of marine resources. These also help to calibrate the older records.²⁶⁰

The authors pursued this centuries-long historical review of the ecological effects of human fishing to spell out the full ecological effects of human decimation of these formerly abundant species.²⁶¹ For example, the historical evidence clearly proves that marine vertebrates once existed in enormous numbers. There were tens of millions of large sea turtles (now endangered) in the Caribbean a few centuries ago, Stellar sea cows (now extinct) throughout the northern Pacific rim, dense populations of sea otters on the Pacific coast of the United States and of huge cod on the Atlantic coast, over a million dugongs in Australian seas, and large populations of baleen whales—gray whales, blue whales, right whales, fin whales, and so on—throughout the world's oceans.²⁶² It is not just the large vertebrates that have disappeared. Smaller invertebrate species such as oysters and conches were “once so abundant as to pose hazards to navigation, but are witnessed now only by massive garbage dumps of empty shells.”²⁶³

Jackson and colleagues argue that human overfishing of once-abundant species over the centuries has wrought extensive changes to marine ecosystems that cannot be observed in conventional studies. They state that “most ecological research is based on local field studies lasting only a few years and conducted sometime after the 1950s without longer term historical perspective.”²⁶⁴ These short-term studies do not even last for the lifespans of important marine species, let alone take into account changes in a particular marine ecosystem over history, rarer events such as cyclones and El Niño currents, or long-term ocean cycles and shifts.²⁶⁵

What an historical review of overfishing makes clear, the authors conclude, is the importance of *ecological extinction* in shaping contemporary marine ecosystems: “[e]cological extinction caused by overfishing precedes all other pervasive human disturbance to coastal

260. *Id.* at 629.

261. *Id.*

262. *Id.* at 629, 631–34.

263. *Id.* at 629 (citing E. Ingersoll, in *THE HISTORY AND PRESENT CONDITION OF THE FISHERY INDUSTRIES* 1–252 (G.B. Goode, ed., 1881)).

264. Jackson et al., *supra* note 37, at 629 (citing J.B.C. Jackson, *Reefs Since Columbus*, 16 *CORAL REEFS* S23 (1997); P.K. Dayton et al., *Sliding Baselines, Ghosts, and Reduced Expectations in Kelp Forest Communities*, 8 *ECOLOGICAL APPLICATIONS* 309 (1998); J.H. BROWN, *MACROECOLOGY* (1995)).

265. *Id.*

ecosystems, including pollution, degradation of water quality, and anthropogenic climate change.”²⁶⁶ Normally, “extinction” refers to the complete loss of an entire species. “Ecological extinction,” in contrast, refers to a situation where a given species is so reduced in number that it can no longer fulfill its ecological role in relation to other species, often changing the structure and weakening the overall health of that ecosystem. For example, Jackson and colleagues note that kelp forest ecosystems in the northern Pacific Ocean, near Alaska, evolved into a balance between the kelp, kelp-eating sea urchins and sea cows, sea-urchin-eating sea otters, and sea-otter- and sea-cow-eating orcas.²⁶⁷ Aboriginal hunting probably decimated the sea cows in prehistoric times, and “European fur traders killed the last sea cow . . . in 1768.”²⁶⁸ As for sea otters, “[a]boriginal Aleuts greatly diminished sea otters beginning around 2500 yr. B.P., with a concomitant increase in the size of sea urchins. Fur traders subsequently hunted otters to the brink of extinction in the 1800s . . .”²⁶⁹ In this fairly simple ecosystem, loss of sea otters meant loss of control on the numbers of sea urchins, which proceeded to decimate the kelp, destroying much of the kelp forest.²⁷⁰ In addition, orcas preyed more extensively on seals and sea lions, which are currently “in drastic decline.”²⁷¹

Once out of balance because of ecological extinction, even relatively simple ecosystems like the Northern Pacific kelp forests are difficult to restore to full productivity. Species-specific legal protections for sea otters were enough, at least initially, to allow the kelp forests in the Northern Pacific to recover,²⁷² demonstrating that passive restoration of marine ecosystems can have positive results. However, as sea otters recovered and became the more prevalent food source, orcas “shifted their diet to sea otters from seals and sea lions.”²⁷³ As a result, the kelp forests are again declining because of the orcas’ increased predation on sea otters.²⁷⁴ Only time—an important component of passive marine restoration—will demonstrate whether the Northern Pacific kelp forests will re-establish a more productive balance between predators and prey.

More complex marine ecosystems historically included redundancy of functions that allowed them to survive, albeit in weakened form, when human overfishing eliminated large vertebrate species. For example,

266. *Id.*

267. *Id.* at 630.

268. *Id.* at 630–31.

269. Jackson et al., *supra* note 37, at 631 (citing C.A. Simenstad et al., 200 SCI. 403 (1978)).

270. *Id.*

271. *Id.*

272. *Id.*

273. *Id.*

274. Jackson et al., *supra* note 37, at 631(citing J.A. Estes et al., 282 SCIENCE 473 (1998)).

southern California kelp forests historically supported more complex food webs than those in the Northern Pacific; not only sea otters but also spiny lobsters and large sheephead fish preyed on sea urchins. In addition, numerous abalone species ate kelp in competition with the sea urchins.²⁷⁵ As a result, although aboriginal and European fur traders rendered the sea otter ecologically extinct in this ecosystem by the late 1800s, "kelp forests did not begin to disappear on a large scale until the intense exploitation and ecological extinction of sheephead, spiny lobsters, and abalone starting in the 1950s."²⁷⁶ Tracing such complex causation of ecosystem damage over time thus demonstrates the importance of biodiversity to marine ecosystem health and productivity.²⁷⁷

Given these examples, Jackson and his colleagues argue "that humans have been disturbing marine ecosystems since they first learned how to fish."²⁷⁸ As a result of their historical investigation, they conclude that:

major structural and functional changes due to overfishing occurred worldwide in coastal marine ecosystems over many centuries. Severe overfishing drives species to ecological extinction because overfished populations no longer interact significantly with other species in the community. . . [Moreover,] [o]verfishing and ecological extinction predate and precondition modern ecological investigations and the collapse of marine ecosystems in recent times, raising the possibility that many more marine ecosystems may be vulnerable to collapse in the near future.²⁷⁹

As demonstrated by the differences between the northern Pacific and southern California kelp forest ecosystems, historical overfishing either immediately and completely disrupted the entire ecosystem or simply rendered the ecosystem more vulnerable to further changes in the future. Thus, the authors resist the idea that we should focus only on immediate temporal explanations of the recent disturbances of marine ecosystems. Causation in marine ecosystem decline, they argue, is far more complex and requires a broader historical perspective. To illustrate, Jackson and colleagues note that seagrass beds are tremendously productive marine ecosystems, supporting manatees, sea turtles, fish,

275. *Id.* (citing M.J. Tegner & P.K. Dayton 57 INTL. COUNCIL EXPLORATION OF THE SEA J. MARINE SCI. 579 (2000)).

276. *Id.* (citing P.K. Dayton et al., *Sliding Baselines, Ghosts, and Reduced Expectations in Kelp Forest Communities*, 8 ECOLOGICAL APPLICATIONS 309 (1998); Tegner & Dayton, *supra* note 275).

277. *Id.* at 636 (citing T.P. Hughes, *Catastrophes, Phase Shifts, and Large-Scale Degradation of a Caribbean Coral Reef*, 265 SCIENCE 1547 (1994); S. Naeem, *Species Redundancy and Ecosystem Reliability*, 12 CONSERVATION BIOLOGY 39 (1998)).

278. *Id.* at 629.

279. Jackson et al., *supra* note 37, at 629.

sharks, rays, and many kinds of invertebrates.²⁸⁰ Despite overfishing of many of these species, especially manatees, sea turtles, and commercially important invertebrates such as oysters, the authors found that “seagrass beds seemed to be highly resilient to human disturbance until recent decades when mass mortality of seagrasses became common and widespread.”²⁸¹

Faced with the recent die-off of seagrasses, scientists looked for contemporary explanations and found that the “[p]roximate causes of these losses include[d] recent increases in sedimentation, turbidity, or disease.”²⁸² A more historical view of causation, however, suggests that these latest disturbances were merely the straws that broke the camel’s back, the last intolerable harms to an ecosystem already suffering severe ecological disturbance. Specifically, the elimination of vast populations of large sea turtles from American waters before the 1800s “profoundly altered the ecology of seagrass beds in ways that increased their vulnerability to recent events.”²⁸³ Sea turtles feed on seagrass, cropping it short, which allows sunlight and water currents to cleanse the area of organic matter and excess nutrients. In the absence of sea turtles, seagrass blades grow long, trapping wastes and interfering with currents—and promoting the growth of slime molds and deleterious microbes, which lead to disease, increased oxygen demand, and hypoxia (oxygen-starved conditions).²⁸⁴

Historical overfishing of invertebrate species such as oysters and clams can produce similar ecosystem vulnerability. Temperate-water estuaries like the Chesapeake Bay currently suffer from increased sedimentation, oxygen deprivation, and “higher frequency and duration of nuisance algal and toxic dinoflagellate blooms, outbreaks of jellyfish,

280. *Id.* at 633.

281. *Id.* (citing H. Kirkman, *Decline of Seagrass in Northern Areas of Moreton Bay, Queensland*, 5 *AQUATIC BOTANY* 63 (1978); E.G. Abal & W.C. Dennison, *Seagrass Depth Range and Water Quality in Southern Moreton Bay, Queensland, Australia*, 47 *MARINE & FRESHWATER RES.* 763 (1996); J.C. Zieman, J.W. Fourqurean, & T.A. Frankovich, *Seagrass Die-off in Florida Bay: Long-term Trends in Abundance and Growth of Turtle Grass, Thalassia testudinum*, 22 *ESTUARIES* 460 (1999)).

282. *Id.*

283. *Id.* at 633–34.

284. Jackson et al., *supra* note 37, at 633–34 (citing J.C. Ogden, in *HANDBOOK OF SEAGRASS BIOLOGY: AN ECOSYSTEM PERSPECTIVE* 173–98 (R.C. Phillips & C.P. McRoy, eds., 1980)); G.W. Thayer, D.W. Engel, & K.A. Bjorndal, *Evidence for Short-Circuiting of the Detritus Cycle of Seagrass Beds by the Green Turtle, Chelonia Mydas L.*, 62 *J. EXPERIMENTAL MARINE BIOLOGY & ECOLOGY* 173 (1983); J.C. Ogden et al., *Diel Foraging Patterns in Juvenile Green Turtles in St. Croix United States Virgin Islands*, 66 *J. EXPERIMENTAL MARINE BIOLOGY & ECOLOGY* 199 (1983); G.W. Thayer et al., *Role of Herbivores in Seagrass Communities*, 7 *ESTUARIES* 351 (1984); J.C. Zieman, J.W. Fourqurean, & T.A. Frankovich, *Seagrass Die-off in Florida Bay: Long-term Trends in Abundance and Growth of Turtle Grass, Thalassia testudinum*, 22 *ESTUARIES* 460 (1999); W. DAMPIER, *A NEW VOYAGE AROUND THE WORLD* (1968)).

and fish kills.”²⁸⁵ As Jackson and his colleagues emphasize, “[m]ost explanations for these phenomena emphasize ‘bottom-up’ increases in nutrients like nitrogen and phosphorus as causes of phytoplankton blooms and eutrophication, an interpretation consistent with the role of estuaries as the focal point and sewer for many land-based, human activities.”²⁸⁶ However, as previously discussed, Chesapeake Bay was also once home to “[v]ast oyster reefs” that “may have filtered the equivalent of the entire water column every 3 days.”²⁸⁷ Although Native Americans and early colonists intensely harvested oysters, Jackson notes that “it was not until the introduction of mechanical harvesting with dredges in the 1870s that deep channel reefs were seriously affected.”²⁸⁸ The oyster fishery collapsed in the early twentieth century, and only then “did hypoxia, anoxia, and other symptoms of eutrophication begin to occur.”²⁸⁹

Chesapeake Bay again demonstrates that once human overfishing disturbs an ecosystem by causing ecological extinction, restoration can be very difficult. According to Jackson, “now that oyster reefs are destroyed, the effects of eutrophication, disease, hypoxia, and continued dredging interact to prevent the recovery of oysters and associated communities.”²⁹⁰ Chesapeake Bay thus demonstrates how our lack of knowledge about causation and about how undisturbed marine

285. *Id.* at 634 (citing R. Elmgren, *Man's Impact on the Ecosystem of the Baltic Sea: Energy Flows Today and at the Turn of the Century*, 18 *AMBIO* 326 (1989); C.B. Officer et al., 223 *SCIENCE* 22 (1984); S.W. Nixon, 41 *OPHELIA* 199 (1995); S.R. Cooper et al., 16 *ESTUARIES* 617 (1993); R.I.E. Newell, *Ecological Changes in Chesapeake Bay: Are They The Result in Overharvesting the American Oyster, Crassostrea virginica*, in *UNDERSTANDING THE ESTUARY: ADVANCES IN CHESAPEAKE BAY RESEARCH, PROCEEDINGS OF A CONFERENCE* 536–46 (M.P. Lynch & E.C. Krome, eds., 1988); B.J. Rothschild et al., *Decline Of The Chesapeake Bay Oyster Population: A Century Of Habitat Destruction And Overfishing*, 111 *MARINE ECOLOGY PROGRESS SERIES* 29 (1994); R.B. Jonas, *Bacteria, Dissolved Organics and Oxygen Consumption in Salinity Stratified Chesapeake Bay, an Anoxia Paradigm*, 37 *AMERICAN ZOOLOGIST* 612 (1997); T.J. Smayda, *Novel and Nuisance Phytoplankton Blooms in the Sea: Evidence for a Global Epidemic*, in *TOXIC MARINE PHYTOPLANKTON* 29–40 (E. Graneli et al. eds., 1990); J.M. Burkholder et al., *New “Phantom” Dinoflagellate Is The Causative Agent Of Major Estuarine Fish Kiss*, 358 *NATURE* 407 (1992); S.R. COOPER, *THE HISTORY OF WATER QUALITY IN NORTH CAROLINA ESTUARINE WATERS AS DOCUMENTED IN THE STRATIGRAPHIC RECORD* (2000)).

286. *Id.* (citing R. Elmgren, *Man's Impact on the Ecosystem of the Baltic Sea: Energy Flows Today and at the Turn of the Century*, 18 *AMBIO* 326 (1989); Officer, *supra* note 285; Nixon, *supra* note 285).

287. *Id.* (citing E. Ingersoll, in *THE HISTORY AND PRESENT CONDITION OF THE FISHERY INDUSTRIES* 1–252 (G.B. Goode, ed., 1881); R.I.E. Newell, *supra* note 285).

288. Jackson et al., *supra* note 37, at 634 (citing R.I.E. Newell, *supra* note 285; B.J. Rothschild et al., *Decline of the Chesapeake Bay oyster population: a century of habitat destruction and overfishing*, 111 *MARINE ECOLOGY PROGRESS SERIES* 29 (1994)).

289. *Id.* (citing C.B. Officer, *supra* note 285; S. R. Cooper et al., 16 *ESTUARIES* 617 (1993); R.I.E. Newell, *supra* note 285; B.J. Rothschild et al., *Decline of the Chesapeake Bay oyster population: a century of habitat destruction and overfishing*, 111 *MARINE ECOLOGY PROGRESS SERIES* 29 (1994)).

290. Jackson, *supra* note 37, at 634 (citing H. S. Lenihan & C. H. Peterson, 8 *ECOLOGICAL APPLICATIONS* 128 (1998)).

ecosystems should function can hamper any active attempts to restore those ecosystems. Jackson points out that “[t]he ecological consequences of uncounted other losses are unknown. Gray whales (now extinct in the Atlantic), dolphins, manatees, river otters, sea turtles, alligators, giant sturgeon, sheepshead, sharks, and rays were all once abundant inhabitants of Chesapeake Bay but are now virtually eliminated.”²⁹¹

The historical losses in marine productivity are almost incredible, and Jackson and his colleagues trace most of the original causes to historical human overfishing. “Overfishing of large vertebrates and shellfish was the first major human disturbance to all coastal ecosystems examined,” they note, and “[e]cological changes due to overfishing are strikingly similar across ecosystems despite the obvious difference in detail. Everywhere, the magnitude of losses was enormous in terms of biomass and abundance of large animals that are now effectively absent from most coastal ecosystems worldwide.”²⁹²

In addition to their main thesis, the authors also conclude that, when historical overfishing is properly considered, three other corollaries respecting marine degradation follow. First, “pollution, eutrophication, physical destruction of habitats, outbreaks of disease, invasions of introduced species, and human-induced climate change all come much later than overfishing in the standard sequence of historical events.”²⁹³ While the authors admit that human disturbance has not yet affected all marine ecosystems, they also conclude that “[e]cological extinction of entire trophic levels²⁹⁴ makes ecosystems more vulnerable to other natural and human disturbances such as nutrient loading and eutrophication, hypoxia, disease, storms, and climate change.”²⁹⁵

Second, the authors postulate that other kinds of environmental harms, such as eutrophication and marine disease, would not occur but for historical overfishing—that overfishing “may be a necessary precondition” for these problems.²⁹⁶ For example, the Chesapeake Bay did not experience oxygen-deprivation problems until its oysters were overfished, even though by that time people had been clearing land for farms and “increas[ing] runoff of sediments and nutrients into the

291. *Id.*

292. *Id.* at 635.

293. *Id.*

294. A “trophic level” is the collection of organisms within a food chain or food web that perform the same basic role in that food chain or web. For example, green plants, photosynthesizing bacteria, and chemo-synthesizing bacteria comprise the first trophic level of producers; herbivores comprise the second (primary consumers); carnivores that eat herbivores comprise the third (secondary consumers); carnivores that eat secondary consumers comprise the fourth (tertiary consumers); and so on. LARRY GONICK & ALICE ATWATER, *THE CARTOON GUIDE TO THE ENVIRONMENT* 72 (1996).

295. Jackson et al., *supra* note 37, at 635.

296. *Id.*

estuary"²⁹⁷ for nearly two centuries. In other words, the historical record suggests that the estuary ecosystem could cope with human pollution so long as the enormous populations of oysters remained in place, effectively filtering the water.²⁹⁸ Moreover, historical overfishing appears to contribute to outbreaks of disease in two ways. On the one hand, overfishing of the target species often allows that species' food sources to overbreed and "become so dense that they are much more susceptible to disease as a result of greatly increased rates of transmission," as with the seagrasses in the Caribbean.²⁹⁹ On the other, overfishing of the target species can allow other disturbances of the marine system—such as the sedimentation and eutrophication of Chesapeake Bay—that further weaken the overfished species and/or allow infectious species to multiply, rendering the overfished species vulnerable to disease.³⁰⁰

Third, the authors downplay the role of climate change in recent outbreaks of marine microbes and disease.³⁰¹ "Most recent changes to coastal marine ecosystems subsequent to overfishing involve population explosions of microbes responsible for increasing eutrophication, diseases of marine species, toxic blooms, and even diseases such as cholera that affect human health."³⁰² Although these changes are relatively recent, the authors argue persuasively that focusing only on twentieth-century causes, such as global climate change, is a mistake that will lead to ineffective regulation. An historical review, in contrast, reveals that "[t]he rise of microbes has occurred at different times and under different climatic conditions in different places," often following human overfishing of larger species.³⁰³ As a result, the authors note, restoration

297. *Id.* (citing S.R. Cooper et al., 16 ESTUARIES 617 (1993)).

298. *Id.*

299. *Id.* (citing W.M. Hochachka & A.A. Dhondt, *Density-Dependent Decline Of Host Abundance Resulting From A New Infectious Disease*, 97 PROC. NAT'L ACAD. SCI. U.S.A. 5303 (2000)).

300. Jackson et al., *supra* note 37, at 635 (citing H.S. Lenihan et al., *The Influence Of Multiple Environmental Stressors On Susceptibility To Parasites: An Experimental Determination With Oysters*, 44 LIMNOLOGY OCEANOGRAPHY 910 (1999); C.B. Officer et al., *Benthic Filter Feeding A Natural Eutrophication Control*, 9 MARINE ECOLOGY PROGRESS SERIES 203 (1982)).

301. *Id.*

302. *Id.* at 636 (citing R. Elmgren, *Man's Impact on the Ecosystem of the Baltic Sea: Energy Flows Today and at the Turn of the Century*, 18 AMBIO 326 (1989); C.B. Officer et al., 223 SCIENCE 22 (1984); Nixon, *supra* note 285; R.B. Jonas, *Bacteria, Dissolved Organics and Oxygen Consumption in Salinity Stratified Chesapeake Bay, an Anoxia Paradigm*, 37 AM. ZOOLOGIST 612 (1997); Smayda, *supra* note 285; J.M. Burkholder et al., *New "Phantom" Dinoflagellate Is The Causative Agent Of Major Estuarine Fish Kiss*, 358 NATURE 407 (1992); C.D. Harvell et al., *Emerging Marine Diseases—Climate Links and Anthropogenic Factors*, 285 SCIENCE 1505 (1999); R.R. Colwell, *Global Climate and Infectious Disease: the Cholera Paradigm*, 274 SCIENCE 2025 (1996)).

303. *Id.* at 635 (citing S.R. Cooper et al., 16 ESTUARIES 617 (1993); R.I.E. Newell, *supra* note 285; B.J. Rothschild et al., *Decline Of The Chesapeake Bay Oyster Population: A Century Of Habitat Destruction And Overfishing*, 111 MARINE ECOLOGY PROGRESS SERIES 29 (1994); S.R. COOPER, THE HISTORY OF WATER QUALITY IN NORTH CAROLINA ESTUARINE WATERS

efforts that focus only on climate and recent pollution, without regard to the absence of overfished species that would normally control problem organisms, are likely to fail.³⁰⁴

III.

THE HISTORICAL VIEW OF OCEAN ECOSYSTEMS AND RESTORATION: IMPLICATIONS FOR U.S. POLICY

Jackson's historical review of the ecological effects of human overfishing emphasizes the already recognized inadequacies of the United States' ocean laws and policies. The United States' myopic focus on particular resources and commercially important species fails to acknowledge how little we know about how the oceans function and the role of these species in larger marine ecosystems. An historical perspective makes this lack of knowledge acutely obvious. The historical perspective also demonstrates that we have become content with oceans that are sickly shadows of what they could be.

More positively, the historical perspective offers a vision of ocean productivity that may be wildly beyond anything Congress had in mind when it passed the Oceans Act. If incorporated into the Act's review of United States ocean law and policy, therefore, this perspective could create an opportunity for the United States to set truly ambitious *and* scientifically accurate restoration goals for its oceans.

A. *The Limits of the Historical Perspective*

Historical science, of course, does not hold all the answers for U.S. ocean policy. For one thing, our oceans are connected to all the other seas of the world, compelling some level of international cooperation and consensus regarding marine restoration. Nevertheless, unlike many marine ecosystems, such as the Black Sea, where many relatively small nations exercise jurisdiction over a contained ecosystem,³⁰⁵ the United States has long national coastlines, and its ocean territories generally open into the wide Atlantic and Pacific Oceans. Thus, the immediate and direct influences of most other nations on our oceans—especially with respect to the critical coastal zone—are attenuated.

Nor can marine restoration efforts ignore other causes of marine degradation besides historical human overfishing. Indeed, Jeremy

AS DOCUMENTED IN THE STRATIGRAPHIC RECORD (2000)). Moreover, the authors suggest, "[m]assive removal of suspension feeders, grazers, and predators must inevitably leave marine ecosystems more vulnerable to invasion" by alien species, helping to explain the "[r]apid expansion of introduced species in recent decades . . ." *Id.* (citing H.S. Lenihan, *Physical-Biological Coupling on Oyster Reefs: How Habitat Structure Influences Individual Performance*, 69 ECOLOGICAL MONOGRAPHS 251 (1999); John J. Stachowicz et al., 286 SCIENCE 1577 (1999)).

304. *Id.* at 636.

305. See WOODWARD, *supra* note 2, at 1–28 (describing the degradation of the Black Sea).

Jackson and his colleagues, in response to criticisms of their *Science* article, emphasized the need for multi-faceted restoration efforts:

If our review can be construed as an argument that restoring the overfished species and habitats degraded by fishing would be sufficient in themselves to counteract the deterioration of coastal marine ecosystems, we apologize. No amount of success in restoring sharks and sea turtles to remote coral reef ecosystems, for example, will counteract the growing coral bleaching induced by global warming and other physical causes. Furthermore, we concur that reduction in nutrient loading to the world's estuaries and coastal seas is a critical component of management strategies to restore lost ecosystem services and reverse eutrophication.³⁰⁶

Thus, even with an historical perspective, one aspect of setting goals for marine restoration must be an assessment of the recent stresses that humans have caused to ocean and coastal ecosystems.

Moreover, our oceans and coasts do not exist independently of the land and freshwater ecosystems that are usually the more common focus of environmental restoration policy. Bruce Babbitt, the former Secretary of the Interior, noted the effect of upstream, land-based pollution on coastal ecosystems. "Out in the Gulf [of Mexico], the sparkling sea water is a blue wash over a dead zone that extends westward to Texas, where the marine life is dying, asphyxiated by fertilizer residue washing down from farmlands a thousand miles upriver."³⁰⁷ Similarly, dams and other waterworks projects affect not only the immediate aquatic ecosystems but also downstream deltas and estuaries; indeed, these "are especially vulnerable, being the furthest habitats downstream."³⁰⁸ Considering such factors could lead to even broader reforms in the United States' marine laws, such as comprehensive water quality regulation that integrates terrestrial and marine protection.

B. The Historical Perspective, Restoration Goals, and Future Political Debate Under the Oceans Act

Notwithstanding these limitations, an historical perspective on marine ecosystems and levels of ocean productivity is critical for policy discussions regarding future marine restoration. It provides policymakers with a full range of goals, allowing the restoration dialog to become a true debate regarding what Americans want our oceans to be. In the terms of the Oceans Act, the historical perspective will provide the public with information that will help it determine what level of productivity it wants as well as needs.

306. Charles Peterson et al., *supra* note 173, at 1590.

307. Bruce Babbitt, *supra* note 158, at 147.

308. Teclaff & Teclaff, *supra* note 156, at 907.

Jackson's research informs us that sea otters in Pacific kelp forests once numbered over 100,000, compared to the 30,000 that exist currently, after being brought back from the edge of extinction; Atlantic cod once had a mean body length of one meter, compared to the current 0.3 meter average; and 620,000 metric tons of oysters per year once thrived in Chesapeake Bay, compared to the 12,000 tons taken per year now.³⁰⁹ Eutrophication of Chesapeake Bay has increased nine-fold in the last two millennia; Tampa Bay has experienced a three-fold decrease in seagrass in the last 121 years; and white abalone have decreased 2000-fold off the coast of California in the last 30 years.³¹⁰ While somewhat depressing, these declines should remind us that the potential productivity of U.S. marine ecosystems is enormous—a fact that makes the *Science* study directly relevant to the Commission on Ocean Policy.

The historical perspective allows us to envision a return to a sea full of giant whales, flotillas of sea turtles, abundant sea otters, and beds of enormous shellfish. It gives us the option, as a nation, to be that ambitious. Would we actually choose to pursue that goal, given the inevitable short- and long-term sacrifices such restoration would require? Maybe not—although the Chesapeake Bay restoration project already actively incorporates historical baselines for oyster productivity into its restoration goals.³¹¹

Even if the United States never attempts to restore its marine ecosystems to conditions that existed centuries or millennia ago, the knowledge of those past levels of productivity forces policymakers to acknowledge that choices regarding future law and policy do exist and that real paradigm shifts are possible. The historical perspective offers visions of ocean productivity so compelling that they should prompt earnest discussions in Congress, as it debates the Commission's report under the Oceans Act, of what we as a nation want our oceans to be.

309. Jackson et al., *supra* note 37, at 632, Table 3.

310. *Id.* at 632–33, Table 3.

311. See, e.g., Virginia Institute of Marine Science, William and Mary College, *Introduction, Molluscan Ecology Program*, at

<http://www.vims.edu/mollusc/monrestoration/restoyreef.htm#intro> (last modified Jan. 3, 2002).

[O]ur goal is to restore the physical structure to encourage oyster success and, subsequently, successful development of complex ecological communities that Chesapeake Bay oyster reefs traditionally supported. Habitats or areas are usually selected for restoration sites on the basis of both historical biological data . . . and local oceanographic data.

Id. Even skeptics regarding the program's success discuss the restoration effort with reference to historical levels of productivity. See, e.g., Donald Boesch et al., *Factors in the Decline of Coastal Ecosystems*, 293 *SCIENCE* 1589, 1590 (Aug. 31, 2001) ("the multistate Chesapeake Bay Program has established the ambitious goal of a 10-fold increase in oyster biomass. But restoration of oysters *even to precolonial abundances* is unlikely" because of pollution-related issues) (emphasis added).

C. *The Historical Perspective and Proposals for the Structure and Focus of U.S. Ocean Regulation*

In addition to offering a vision of intense ocean productivity, the study by Jackson and his colleagues also contains important guidance for marine resources regulation. As has been discussed, most current regulation addresses recent causes of marine degradation, especially causes that are relatively easy to address, such as point sources of pollution, but this approach is inadequate to address the longer-term causes of marine degradation. The historical view also makes clear that the United States' current resource-by-resource and species-by-species regulatory regime for ocean resources needs to be replaced by an all-encompassing, ecosystem-based regulatory framework.³¹² "The central point for successful restoration is that loss of economically important fisheries, degradation of habitat attractive to landowners and tourists, and emergence of noxious, toxic, and microbial diseases are all part of the same standard sequence of ecosystem deterioration that has deep historical roots."³¹³ Successful ocean restoration and management will not occur, as Jackson states, if the federal and state governments respond "only to current events on a case-by-case basis Instead, they need to be addressed by a series of bold experiments to test the success of integrated management for multiple goals on the scale of entire ecosystems."³¹⁴

In addition, the new regulatory regime will need to emphasize restoration instead of the "maximum sustainable use" that has proven so unsustainable in fact. A continued emphasis on extractive uses will probably result in continued marine degradation; it certainly will keep the United States from seriously improving marine productivity and achieving the economic benefits that the Oceans Act intends.

D. *The Practicalities of Marine Restoration*

The scientific tools to accomplish marine restoration and the species themselves are already largely available. Jackson informs that "with few

312. The inadequacy of resource-by-resource regulation has been noted in other restoration contexts as well. With respect to restoring the Colorado River, for example, Luther Propst and Peter Culp have noted

the inability of our legal and political systems to deal with the complex relationships that underlie environmental problems Our laws are premised on fundamental separations and boundaries: between humanity and nature, between water in the stream and water in the ground, between my land and your land.

Propst et al., *supra* note 158, at 260.

313. Jackson et al., *supra* note 37, at 636 (citing J.B.C. Jackson, *What Was Natural In The Coastal Oceans?*, 98 PROCEEDINGS OF THE NAT'L ACAD. SCI. U.S.A. 5411 (2001)).

314. *Id.*

exceptions, such as the Caribbean monk seal and Stellar's sea cow, most species that are ecologically extinct probably survive in sufficient numbers for successful restoration."³¹⁵ In addition, the tools already exist to allow scientists "to design large-scale, adaptive experiments for ecosystem restoration, exploitation, and management." Around the world, such experiments have already shown some success in restoring oyster colonies and coral reefs.³¹⁶

Such experiments are a form of active species restoration, and the success of such reintroductions may vary widely from place to place. However, studies of passive restoration in the form of MPAs and marine reserves indicate that marine reserves in particular may be equally successful in allowing ecologically extinct marine species to recover over time. Indeed, both MPAs and marine reserves are particularly valuable for remediating the source of ecosystem damage that the historical perspective reveals as being temporally and ecologically primary: overfishing.

MPAs in the United States are already demonstrating their value. The oldest fully protected marine reserve in the United States is the Merritt Island National Wildlife Refuge at Cape Canaveral, Florida.³¹⁷ A 1962 closure to restrict access to the Kennedy Space Center excluded all boats from the area, coincidentally "secure[ing] fish populations."³¹⁸ Since 1962, many of the fish species have recovered, to the point where the reserve now supplies "trophy fish" to the surrounding waters.³¹⁹

The Bush Administration is already constructing a national system of MPAs pursuant to its adoption of the Clinton MPA Executive Order.³²⁰ Such efforts, however, originated from and are being pursued by only the executive branch, making it too easy for new administrations to undermine marine restoration. As the Merritt Island Refuge demonstrates, long-term regulatory programs are necessary to meet marine restoration goals. "Recovery from [a] heavily exploited state takes time, particularly for the accumulation of large individuals of long-lived species in reserves."³²¹ Species with longer lifespans (not only

315. *Id.* (citing D.H. Janzen & P.S. Martin, *Neotropical Anachronisms: The Fruits the Gomphotheres Ate*, 215 *SCIENCE* 19 (1982)).

316. *Id.* (citing R.E. Ulanowicz & J.H. Tuttle, *The Trophic Consequences of Oyster Stock Rehabilitation in Chesapeake Bay*, 15 *ESTUARIES* 298 (1992)).

317. WING, *supra* note 211, at 17.

318. *Id.*

319. *Id.* at 17-18.

320. Exec. Order No. 13,158, 65 Fed. Reg. 34,909 (May 26, 2000) (President Clinton's Marine Protected Area Executive Order); Press Release, Donald L. Evans, Secretary of Commerce, Supplement to Executive Order 13,158 (June 4, 2001), available at http://mpa.gov/frontmatter/sup1_eo.html. NOAA has established a website for the growing national network of MPAs at <http://mpa.gov>.

321. MPAS: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 192.

certain species of fish, but also most of the large vertebrates) take longer to recover, even in areas with absolute protections.³²² Therefore, meeting restoration goals will require regulatory patience, and long-lasting congressional, rather than transitory executive, action is needed. In carrying out the Oceans Act, therefore, Congress should write the MPA Executive Order's goal of a national system of representative MPAs and marine reserves into federal statutes. Moreover, to make the MPA system truly effective, Congress should adopt recommendations that 10 to 20 percent of the seas be protected by such areas.³²³

As a corollary, a restoration regime will require vast expansion of current knowledge about marine ecosystems, both contemporary and historical. As Jackson and his colleagues note, "more specific paleological, archaeological, and historical data should be obtained to refine the histories of specific ecosystems and as a tool for management."³²⁴ Historical investigations may reveal what functions and species are missing from a marine ecosystem, but effective use of that knowledge requires ocean managers to also understand how the marine ecosystem currently functions. Thus, when the Commission on Ocean Policy and Congress review the United States' current marine laws and policies, they should prioritize funding and other encouragement of ocean research.

CONCLUSION

"Restoration concretizes the questions of how and why we value the environment."³²⁵ America's citizens, like its ocean-related laws and policies, traditionally have undervalued the seas.³²⁶ However, as degradation of ocean ecosystems becomes more obvious, marine productivity decreases, and more knowledge about the seas is gathered, the perceived value of sustainably functional ocean ecosystems is beginning to increase.³²⁷ The Oceans Act of 2000 reflects this new perception, and the Committee should seize upon this enthusiasm by

322. *Id.*

323. *Id.* at 116.

To represent and replicate habitats adequately in a reserve system designed for conserving biodiversity, reserves covering more than 10% of the seas are likely to be required. However, providing insurance against overfishing and protecting nursery areas, spawning aggregation sites, or migration bottlenecks may require reserves covering a larger fraction of a given region.

Id.

324. *Id.*

325. Flournoy, *supra* note 158, at 204.

326. AGARDY, *supra* note 4, at 14.

327. See *id.* at 10–12 (discussing the growing awareness of degradation and noting that "it is ironically the most productive, most ecologically critical and most highly valued habitats that we are degrading the fastest").

making bold recommendations to Congress on how to restore the nation's oceans.

Restoring sustainably functional and increasingly productive marine ecosystems will require sacrifice and patience as well as a restrictive regime of regulation that effectively prohibits overexploitation of marine species. Many marine ecosystems are already in danger of collapse, a result that could be equally devastating to humans who depend on those ecosystems, as the collapse of Canada's cod fishery³²⁸ and the impending collapse of the Pacific Northwest's salmon fisheries³²⁹ have demonstrated. Ignoring the historical perspective in marine ecosystem management increases the likelihood that more collapses will occur.³³⁰

Policymakers seeking to establish a restoration regime based on ecosystem protection and an historical perspective are likely to face two main sets of difficulties. The first set will be the scientific difficulties in pursuing restoration, such as identifying historical baselines and describing ecosystem functions. The second set of difficulties will be political—choosing a goal for restoration based on the historical effects of human overfishing and writing a commitment to restoration of marine ecosystems into all U.S. ocean law and policy. Fortunately, the means for achieving much marine restoration—MPAs and marine reserves—are already known to be “key tool[s] in saving the earth's seas from ecological ruin.”³³¹ Two Administrations, one Democratic, one Republican, have already committed the executive branch to their promotion.

Certain aspects of MPAs increase the chances that they could play a role in the successful restoration of marine ecosystems and their functions. MPAs fit the preferred “project model” of restoration that Alyson Flournoy has identified: (1) they are place-based, that is, “conceived of to rectify a problem or serve an objective related to a particular geographic location or ecosystem”; (2) they generally “rectify harms that were produced unintentionally, often before the consequences of the degrading activity were known”; and (3) there are “identifiable values,” such as restoration of fishing stocks or protection of tourist-drawing coral reefs, “that can be advanced by restoration.”³³² In addition, as has been discussed, MPAs and marine reserves are generally passive

328. See generally MICHAEL HARRIS, LAMENT FOR AN OCEAN: THE COLLAPSE OF THE ATLANTIC COD FISHERY: A TRUE CRIME STORY (1998) (discussing the history of Canada's cod fishery and the political and ecological causes of its collapse).

329. See, e.g., CARL SAFINA, SONG FOR THE BLUE OCEAN: ENCOUNTERS ALONG THE WORLD'S COASTS AND BENEATH THE SEAS 121–301 (1997) (discussing the state of the salmon fisheries).

330. Jackson et al., *supra* note 37, at 636.

331. AGARDY, *supra* note 4, at 11.

332. See Flournoy, *supra* note 158, at 206–07.

restoration measures used primarily to allow ecosystems damaged by overfishing to recover naturally.³³³ Therefore, marine reserves and MPAs offer significant opportunities for restoration with low ecological risk even before scientific research is complete.

Currently, however, federal dedication to MPAs is only an executive commitment—and one that teetered on the edge of reconsideration when the Bush Administration came into power in January 2001.³³⁴ To be effective over the long haul, the MPA program needs the security of federal legislation and congressional funding, especially given the amount of marine protection that experts deem necessary.

Therefore, in carrying out its duties under the Oceans Act of 2000, the Committee on Ocean Policy should recommend, and Congress should enact, federal legislation that commits the United States to a system of MPAs for the foreseeable future. The MPA system should be designed to restore marine biodiversity, the health of marine ecosystems, and sustainable productivity of marine organisms that are currently ecologically extinct. The system's goals should be defined with reference to historical levels of productivity. Moreover, the Committee and Congress should use the possibility of dramatically increased ocean productivity as a means to stimulate the necessary scientific research and theory to support the restoration goals adopted.³³⁵

The Oceans Act's overall goal for United States marine regulation is "a coordinated, comprehensive, and long-range national policy for the responsible use and stewardship of ocean and coastal resources for the benefit of the United States."³³⁶ To achieve that goal, Congress should

333. MPAs: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 73.

334. Immediately upon taking over the Presidency, President Bush issued a "Regulatory Review Plan," 60 Fed. Reg. 7702 (Jan. 24, 2001), which, among other things, delayed EPA's new ocean discharge criteria—which EPA had designed specifically to implement the MPA Executive Order—for over a year. ENVIRONMENTAL PROTECTION AGENCY, OCEAN DISCHARGE CRITERIA: REVISIONS TO THE OCEAN DISCHARGE CRITERIA REGULATIONS 1 (2001), available at http://www.epa.gov/owow/oceans/protecting_oceans/cwa403rule.pdf; 66 Fed. Reg. 62,368, 62,370 (Dec. 3, 2001). In addition, the Bush Administration waited until June 2001 to officially adopt the MPA Executive Order. Press Release, Donald L. Evans, Secretary of Commerce, Supplement to Executive Order 13,158 (June 4, 2001), available at http://mpa.gov/frontmatter/sup1_eo.html.

335. MPAs: TOOLS FOR SUSTAINING OCEAN ECOSYSTEMS, *supra* note 8, at 143 ("Although there is a well-developed theory of terrestrial reserves . . . a corresponding theory for marine systems has yet to be fully developed.") (citing A.J. Higgs & M.B. Usher, *Should Nature Reserves Be Large Or Small?*, 285 NATURE 568-69 (1980); M. Gilpin & M.E. Soule, *Minimum Viable Populations: Processes of Species Extinction*, in CONSERVATION BIOLOGY: THE SCIENCE OF SCARCITY AND DIVERSITY 19-34 (1986); R.L. Pressey et al., *Beyond Opportunism: Key Principles for Systematic Reserve Selection*, 8 TRENDS IN ECOLOGY & EVOLUTION 124 (1993); D. Simberloff, *No Reserve is An Island: Marine Reserves and Nonindigenous Species*, 66 BULLETIN OF MARINE SCI. 567, 567-80 (2000)).

336. Oceans Act of 2000, Pub. L. No. 106-256, § 4(a), 114 Stat. 644.

give one or two agencies comprehensive authority to regulate all uses of the ocean on an ecosystem basis. The goal of such concentrated authority should be to restore each marine ecosystem to a particular historical level of productivity, which is based on historical studies. The primary means of achieving such restoration should be a system of MPAs and marine reserves, with the agency or agencies using marine zoning to designate 10 to 20 percent of the nation's marine waters off-limits to extractive uses. Only by leaving large areas of the seas alone can we once again benefit from the oceans' full ecological—and economic—productivity.

