The Other Side of Sustainable Aquaculture: Mariculture and Nonpoint Source Pollution

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The eighty-two members of the North Carolina Shellfish Growers Association "engage[] in the cultivation, harvesting, production, and marketing of oysters, clams, and other shellfish in North Carolina waters . . . ."[1] Members of the Association "lease waters from the State for the cultivation and harvesting of shellfish," including the "seeding" of the area with cultured juvenile shellfish and the installation of "systems of floats to cultivate oysters in the water column above the bottom."[2] In particular, members have leased coastal waters off the Morris Landing Track for such purposes.[3]

Unfortunately, according to the members of the Association, Holly Ridge Associates "excavated massive drainage ditches in wetlands" on the Morris Landing Track and "caused repeated and continuing discharges of pollutants into wetlands and surface waters on and adjoining the tract."[4] "The ditches were dug with vertical slopes which since being excavated have continuously eroded and collapsed throughout the entire network."[5] As a result, according to the Association, every time it rains on this portion of North Carolina,

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1. Complaint at 3, North Carolina Shellfish Growers Ass'n v. Holly Ridge Assocs., L.L.C., No. 7:01-CV-36-F(1) (E.D.N.C. filed Feb. 20, 2001), *available at* http://www.selcga.org/polfs/stamp_sound_lawsuit.pdf (last visited Feb. 21, 2001).
2. *Id.* at 5.
3. *Id*.
4. *Id*. at 1.
5. *Id*. at 15.

"significant amounts of sediment collapse into the ditches, are transported through the ditches, and are discharged into . . . [the] wetlands on site, Cypress Branch, its tributaries, and directly into the coastal marsh."[6] The result is turbidity and sediment loading in the shellfish waters[7]—and a lawsuit in federal court where the Association is attempting to protect water quality so that its members' mariculture operations in North Carolina's coastal waters can flourish.

Mariculture is the aquaculture of the sea. Aquaculture, in turn, is "the propagation and rearing of aquatic organisms in controlled or selected aquatic environments for any commercial, recreational, or public purpose."[8] Various arms of the U.S. government are promoting sustainable mariculture as a means of increasing the U.S.'s domestic seafood supplies and of equalizing our balance of trade in these products.

Sustainable mariculture,[9] however, is intimately tied to ocean water quality. To date, the agencies that regulate aquaculture—the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Agriculture (USDA)—focus primarily on the problems that aquaculture can *cause* in the environment, such as increased water pollution. Nevertheless, as the North Carolina Shellfish Growers Association demonstrated, there is another water quality issue regarding sustainable mariculture. Mariculture depends on healthy ocean water quality. However, mariculture facilities located in coastal

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6. *Id*. at 21-22.

7. *Id*. at 21-22.

8. NOAA, DEP'T OF COMM., SUSTAINABLE FISHERIES—OBJECTIVE 4, NOAA FISHERIES STRATEGIC PLAN, *available at* http://www.nmfs.noaa.gov/om2/obj-4.html (last visited Dec. 20, 2001).

9. Sustainable mariculture is a specific category of sustainable development. Sustainable development:

> is based on a vision of society directed at human quality of life, opportunity, and freedom. It is based on an understanding that the economic, social, environmental, and security goals of society together provide a foundation for realizing that vision. These goals, in turn, can be realized completely and coherently only if they are achieved at the same time.

John C. Dernbach, *Sustainable Development: Now More Than Ever*, 32:1 Envtl. L. Rep. 10003, 10003 (Jan. 2002).

waters are subject to the increasing problems of coastal water pollution. While some such water pollution derives from federally-regulated point sources of pollution, an increasingly large and destructive percentage of coastal pollution comes from upstream, land-based nonpoint source pollution.

This Article argues that if the United States wants to establish a sustainable mariculture industry, it must better control ocean water quality and upstream water pollution, particularly land-based nonpoint source pollution. Part I describes the types, location, and economic value of aquaculture and mariculture in the United States. Part II discusses how the United States currently regulates aquaculture operations to protect water quality. Part III examines the problem that upstream water pollution poses to sustainable aquaculture in the United States, discussing the various types of pollution pressures on the coastal zone and the problems that upstream water pollution can pose for mariculture operations.

I. AQUACULTURE AND MARICULTURE IN THE UNITED STATES

Worldwide, mariculture offers the promise of supplying increasing populations of human beings with steady supplies of seafood, despite dwindling numbers of wild fish and seafood stocks.

> Global production of farmed fish, shrimp, clams, and oysters more than doubled in weight and value during the 1990s while landings of wild-caught fish remained level. As a result, many people look to this growth in aquaculture to relieve pressure on ocean fish stocks, most of which are fished at or beyond capacity, and to allow wild populations to recover.[10]

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10. Rosamond L. Naylor et al., *A Watershed Academy Web Stepping Stone to Learning—Effects of Aquaculture on World Fish Supplies*, *available at* http://www.epa.gov/watertrain/step8aabstr.html (last visited Dec. 20, 2001). One author predicts that:

> Expected increases in world population are projected to intensify the global demand for edible seafood. The aquaculture industry, which propagates and rears aquatic plants and animals, can provide consumers with high-quality, safe, and affordable seafood and other important fish products, and thereby reduce pressure on wild stocks and help their recovery.

OFFICE OF WATER, EPA, *Aquaculture*, *in* TURNING TO THE SEA: AMERICA'S OCEAN FUTURE,

As a result of this promotion, mariculture is likely to raise sustainability issues for decades to come.[11]

The aquaculture industry is valued at $40 billion worldwide, including almost $1 billion in production in the United States.[12] For the United States, mariculture holds out the promise not just of increased food supplies, but also improvements in our trade status:

> Improving U.S. aquaculture production can simultaneously provide more seafood to domestic markets and help offset the U.S. trade deficit in edible seafood products, which has increased by 139% since 1992 and now stands at $6 billion annually—the largest for any agricultural commodity. Aquaculture can also make major contributions to U.S. local, regional, and national economies by creating business opportunities both here and abroad and by providing employment in a new and diverse industry.[13]

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available at http://www.epa.gov/owowwtr1/oceans/yoto/oceanrpt/aquacult.html (last visited Dec. 20, 2001).

11. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *Introduction*, *in* NOAA'S AQUACULTURE POLICY, *at* http://swr.ucsd.edu/fmd/bill/aquapol.htm (Feb. 13, 1998) ("Worldwide fisheries production will be inadequate to meet the needs of the world's population, without supplementation through aquaculture.").

12. *See* OFFICE OF WATER, EPA, *supra* note 10, at 20.

13. *Id*. More recently, the USDA noted that:

> Over the last 5 years the amount of seafood imported into the United States has grown considerably. Much of the increase has come from aquacultural production in other countries specifically targeted to high-value markets, like the United States. In many cases, the governments in these countries have looked on the growth of the aquaculture sector as a valuable source of foreign exchange earnings. A good example is the growth of the global shrimp farming industry. In 2000, U.S. shrimp imports were valued at $3.8 billion and those from Thailand alone were valued at $1.5 billion. For 2000, the value of imported shrimp, Atlantic salmon, and tilapia totaled $4.6 billion. To put this in perspective, imports of these three aquacultural products in 2000 were worth as much as the combined exports of the U.S. broiler and hog industries.
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> With the size of the seafood market, the strength of the dollar, and a sluggish economy in Japan, traditionally the world's largest seafood importer, more and more foreign aquacultural producers are expected to target the United States seafood market in the coming years. They can do this through the introduction of products that they have an economic advantage in producing or they can produce products that have an existing market in the United States. Two examples of the latter strategy are imports of crawfish meat from China and frozen catfish fillets from Vietnam. While the domestic aquaculture industry is expected to face strong competition for the remainder of 2001

In addition, the United States could become a world leader in sustainable mariculture, by both "developing sustainable aquaculture technologies based on renewable resources and [by] advancing international guidelines for the industry, which provides 25% of the world's fish supplies."[14]

Currently, however, "[t]he U.S. lags behind other nations in the use of aquaculture to meet the growing demand for seafood in the global marketplace."[15] While mariculture provides 25% of the world's fish supplies, production in the United States "currently supplies less than 10% of the nation's seafood demands."[16]

Nevertheless, aquaculture in general is a significant and growing industry in the United States, with "[p]otential purposes . . . [that] include bait production, wild stock enhancement, fish culture for zoos and aquaria, rebuilding of populations of threatened and endangered species, and food production for human consumption."[17] "Between 1980 and 1998, the value of U.S. aquacultural production rose more than 400 percent to nearly $1 billion."[18] Of that total, approximately 71% of sales comes from aquacultured food fish, 9% from mollusks such as oysters and clams, 7% from ornamental fish, and

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and into 2002 from imports of foreign aquacultural products, it will also face competition from the domestic poultry and livestock industries.

David J. Harvey, *Imports Provide Competition for Domestic Production*, AQUACULTURE OUTLOOK, Oct. 10, 2001, at 1 (LDP-AQS-14), *available at* http://www.ers.usda.gov.

14. *See* OFFICE OF WATER, EPA, *supra* note 10, at 20.

15. *See* NOAA, DEP'T OF COMM., *supra* note 8. For more general discussions of the various legal issues involved in promoting aquaculture and mariculture, see generally Ronald J. Rychlak, *Ocean Aquaculture*, 8 FORDHAM ENVTL. L.J. 497 (1997); D. Douglas Hopkins et al., *An Environmental Critique of Government Regulations and Policies for Open Ocean Aquaculture*, 2 OCEAN & COASTAL L.J. 235 (1997); Ronald J. Rychlak & Eileen M. Peel, *Swimming Past the Hook: Navigating Legal Obstacles in the Aquaculture Industry*, 23 ENVTL. L. 837 (1993); Tim Eichenberg & Barbara Vestal, *Improving the Legal Framework for Marine Aquaculture: The Role of Water Quality Laws and the Public Trust Doctrine*, 2 TERR. SEA. J. 339 (1992).

16. *See* OFFICE OF WATER, EPA, *supra* note 10, at 20.

17. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11; *see also* NOAA, DEP'T OF COMM., *supra* note 8.

18. ECON. RESEARCH SERV., USDA, *Aquaculture Briefing Room*, *at* http://www.ers.usda.gov/briefing/aquaculture/ (last updated Dec. 4, 2000).

approximately 4% each from baitfish and crustaceans.[19] Looking just at mariculture:

> [o]ver the first six months of 2001, U.S. exports of oysters, mussels, and clams totaled 4.7 million pounds, up 17 percent from first-half 2000. Oyster exports increased the most, rising 30 percent to 1.9 million pounds. This is the third year in a row that oyster exports have grown.[20]

Other mariculture products in the United States include Atlantic and Pacific salmon (fresh, frozen, and canned) and shrimp (fresh, frozen, and prepared).[21]

According to 1997 data, "the aquaculture industry includes close to 5000 land based and marine environment facilities. The aquaculture industry has facilities located in every state and territory, and is currently one of several growing segments of U.S. agriculture."[22] The top five states for aquaculture sales, in order, are: Mississippi, Arkansas, Florida, Maine, and Alabama.[23] As this ranking suggests, most aquaculture farm acreage—68%—is in the southern states; the northeastern, western, and north central states account for about 10% each.[24] Southern states also account for 65% of the value of aquaculture products sold, while western states account for 17%, northeastern states account for 13%, and north

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19. NAT'L AGRIC. STATISTICS SERV., USDA, *Value of Aquaculture Products Sold by Category*, 1998 CENSUS OF AQUACULTURE: QUICKFACTS, *available at* http://www.nass.usda.gov/census/census97/aquaculture/quickfacts/indexp7.htm (last visited Dec. 20, 2001).

20. Harvey, *supra* note 13, at 8.

21. *Id*. at Table 5.

22. OFFICE OF WATER, EPA, *Effluent Guildlines: EPA Expands Focus on Nutrient Pollution* (Feb. 2000), *at* http://www.epa.gov/ost/guide/aquaculture/factsheet.html (last revised Nov. 20, 2001).

23. NAT'L AGRIC. STATISTICS SERV., USDA, *First Aquaculture Census Catches Nearly $1 Billion in Sales*, USDA, *at* http://www.usda.gov/nass/events/news/aqua-results.htm (Feb. 1, 2000). To round out the top ten, the next five states in aquaculture production are: Washington, Louisiana, California, Idaho, and Virginia. NAT'L AGRIC. STATISTICS SERV., USDA, *Top Ten States Value of Aquaculture Products Sold*, *in* 1998 CENSUS OF AQUACULTURE: QUICKFACTS, *at* http://www.nass.usda.gov/census/ census97/aquaculture/quickfacts/indexp5.htm (last visited Dec. 20, 2001).

24. NAT'L AGRIC. STATISTICS SERV., USDA, *Aquaculture Farms by Region*, *in* 1998 CENSUS OF AQUACULTURE: QUICKFACTS, *at* http://www.nass.usda.gov/census/census97/aquaculture/quickfacts/indexp1.htm (last visited Dec. 20, 2001).

central states account for 3%.[25]

Recognizing the importance of aquaculture and mariculture to the U.S. economy, the federal government actively encourages these industries' development and expansion. For example, the National Aquaculture Development Act of 1980, amended in 1985, established the Joint Subcommittee on Aquaculture (JSA), which is a coordinating group chaired by USDA. The JSA developed the National Aquaculture Development Plan, which identifies the relative roles of USDA, the Department of the Interior, and the Department of Commerce, and established a strategy for implementation of the aquaculture industry in the United States.[26]

Several other federal regulatory programs, generally administered through the Department of Commerce, NOAA, and the National Marine Fisheries Service (NMFS), also encourage the development of aquaculture in the United States.[27] Many of these federal programs fund aquaculture projects. For example, pursuant to a 1980 Memorandum of Understanding between USDA, the Department of

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25. NAT'L AGRIC. STATISTICS SERV., USDA, *Value of Aquaculture Products Sold by Region*, *in* 1998 CENSUS OF AQUACULTURE: QUICKFACTS, *at* http://www.nass.usda.gov/census/census97/aquaculture/quickfacts/indexp2.htm (last visited Dec. 20, 2001).

26. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11.

27. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11, at *Introduction*, *Current Status of Aquaculture in NOAA*. Federal legislation authorizing or encouraging aquaculture includes: Agriculture and Food Act of 1980, 7 U.S.C. §§ 1431e, 1433a, 1446c-1, 1736h-1736l, 2029, 2242, 2270-2273, 2661-2667, 3124, 3223, 3317-3336, 3471-3473, 4004a, 4101-4110, 4201-4209, 4301-4319 (1994); 16 U.S.C. §§ 3451-3461 (1994); Anadromous Fish Conservation Act, 16 U.S.C. §§ 757a-757f (1994); Clean Water Act, 33 U.S.C. §§ 1251-1387 (1994); Coastal Zone Management Act, 16 U.S.C. §§ 1451-1465 (1994 & Supp. II 1996); Columbia Basin Project Act, 16 U.S.C. §§ 835c-1 to 835c-4 (1994); Endangered Species Act, 16 U.S.C. §§ 1531-1544 (1994); Fish and Wildlife Act of 1956, 16 U.S.C. §§ 742a-742j-2 (1994); Interjurisdictional Fisheries Act of 1986, 16 U.S.C. §§ 4101-4107 (1994); Magnuson-Stevens Fisheries Conservation and Management Act, 16 U.S.C. §§ 1801-1882 (1994 & Supp. II 1996); Marine Mammal Protection Act, 16 U.S.C. §§ 1361-1421h (1994); Merchant Marine Act of 1936, Title XI, 46 U.S.C. app. §§ 1101-1131 (1994); National Aquaculture Act of 1980, 16 U.S.C. §§ 2801-2810 (1994); National Environmental Policy Act, 42 U.S.C. §§ 4321-4370a (1994); National Sea Grant College Program Act, 33 U.S.C. §§ 1121-1131 (1994); Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, 16 U.S.C. §§ 4701-4751 (1994); Rivers and Harbors Act of 1899, 33 U.S.C. §§ 401-418 (1994); Saltonstall-Kennedy Act, 15 U.S.C. § 713c-3 (1992); Water Resources Development Act, 33 U.S.C. §§ 59c-3, 426h, 426h-1, 426q-1, 467d-467j, 576b, 635a, 701b-13, 1272, 2284a, 2284b, 2313a, 2313b, 2321a, 2323a, 2326a, 2326b, 2330 (1994). *See also* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11, *Authorizing Legislation*, *in* NOAA'S AQUACULTURE POLICY, *available at* http://swr.ucsd.edu/fmd/bill/aquapol.htm (Feb. 13, 1998).

Commerce, and the Department of Interior, NMFS and the National Sea Grant College Program "carried out aquaculture research and development on marine, estuarine, and anadromous species."[28] "Aquaculture related projects account for approximately $10 million direct and matching Sea Grant funds on an annual basis,"[29] and "[t]he combined impact of Sea Grant-developed technology amounts to at least $100 million annually and supports thousands of jobs in the U.S. economy."[30] In the late 1990s, NMFS spent "approximately $10 million per year for the operation of 25 major salmon hatcheries in the Columbia River Basin"[31] (Oregon and Washington) and approximately $20 million for salmon enhancement projects in Alaska.[32] More generally, "the Saltonstall-Kennedy Grant Program has provided funding for commercial aquaculture projects of between $500,000 and $1.7 million dollars annually,"[33] while "[i]n FY1994 and FY1995, the Northeast Fishing Industry Grants program supplied $1.2 million and $2.19 million respectively for aquaculture-related projects. These projects were aimed at creating commercial development opportunities for displaced New England fishermen."[34]

In addition, NOAA considers mariculture to be vital to maintaining sustainable fisheries in the United States. In its *Fisheries Strategic Plan*,[35] the fourth objective for Sustainable Fisheries is to "[p]romote the development of robust and economically sound aquaculture."[36]

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28. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11. Anadromous species are fish, such as salmon, that begin life in fresh water, then migrate out to sea, and then return to fresh water to spawn.

29. *See id.* at *Current Status of Aquaculture in NOAA: OAR*.

30. *See id.*

31. *See id.* at *Current Status of Aquaculture in NOAA: NMFS*.

32. *Id*.

33. *Id*.

34. *Id*.

35. NOAA, DEP'T OF COMM., FISHERIES STRATEGIC PLAN (June 2001), *available at* http://www.nmfs.noaa.gov/om2/nmfsplan.pdf.

36. *See* NOAA, DEP'T OF COMM., *supra* note 8, at *Sustainable Fisheries—Objective* 4. To that end, NOAA promised to:

> (1) "[p]romote the commercial rearing of at least seven new species"; (2) "[r]educe the time and cost of permitting environmentally sound aquaculture ventures"; (3) "[p]rovide financial assistance for environmentally sound aquaculture ventures"; (4) "[i]dentify areas in coastal waters and the EEZ suitable for environmentally sound

II. THE CURRENT REGULATORY FOCUS: REGULATING AQUACULTURE AND MARICULTURE TO PROTECT WATER QUALITY

A. Aquaculture's and Mariculture's Potential Effects on the Environment

Although "[p]roduction of farmed fish and shellfish does increase world fish supplies,"[37] this productivity may also cause harm to the environment. These harms have been the focus of much aquaculture-related regulation. As the EPA emphasized, "the continued growth of aquaculture in land-based systems and coastal environments and any expansion of aquaculture into the U.S. Exclusive Economic Zone must be conducted in an environmentally sound manner."[38] Even those persons and organizations who extol the potential bounty of aquaculture and mariculture recognize the need for greater regulatory oversight and permitting procedures "to minimize any adverse impacts of aquaculture on the environment and wild stocks,"[39] to "[p]lan for disaster mitigation and prevention related to aquaculture" in the coastal zone,[40] and to establish "national criteria for environmentally safe aquaculture operations."[41]

One such environmental harm, perversely, is the possible increased pressure on wild fish stocks to feed the farmed fish and seafood. "[B]y using increasing amounts of wild-caught fish to feed farmed shrimp and salmon, and even to fortify the feed of herbivorous fish such as carp, some sectors of the aquaculture industry are actually increasing the pressure on ocean fish populations."[42] This feeding pressure derives mainly from the choice of fish farmed. In particular, aquaculture of carnivorous marine

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aquaculture development"; and (5) "[d]evelop and implement environmentally sound aquaculture technologies and practices."

Id.

37. Naylor et al., *supra* note 10.

38. *See* OFFICE OF WATER, EPA, *supra* note 10, at 20.

39. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11, at *NOAA Policy: Research, Development, and Technology Transfer: Environmental Impacts and Standards*.

40. *Id*. at *NOAA Policy: Research, Development, and Technology Transfer: Coastal Management*.

41. *Id*. at *NOAA Policy: Environmental Safeguards: Permit Procedures*.

42. Naylor et al., *supra* note 10.

species, such as shrimp, salmon, cod, seabass, and tuna, has expanded and intensified rapidly, but "[p]roduction of a single kilogram of these species typically uses two to five kilograms of wild-caught fish processed into fish meal and fish oil for feed."[43] Farming of these species increased because they are high-value food products, but "[i]f the goal of aquaculture is to produce more fish for consumers than can be produced naturally, then it will become increasingly counterproductive to farm carnivores that must be fed large amounts of wild-caught fish that form the foundation of the ocean food chain."[44] Instead, it is the "non-carnivorous species such as marine mollusks and carps [that] account for most of the current net gain in world fish supplies from aquaculture."[45]

In addition, aquaculture can "degrade[] the marine environment and diminish[] the ecological life support services it provides to fish, marine mammals, and seabirds, as well as humans."[46] Worldwide, such degradation can include:

- Destruction of hundreds of thousands of hectares of mangrove forests and coastal wetlands for construction of aquaculture facilities
- Use of wild-caught rather than hatchery-reared finfish or shellfish fry to stock captive operations, a practice that often leads to a high rate of discarded bycatch of other species
- Heavy fishing pressure on small ocean fish such as anchovies for use as fish meal, which can deplete food for wild fish such as cod, as well as seals and seabirds
- Transport of fish diseases to new waters and escapes of non-native fish that may hybridize or compete with native wild fish.[47]

43. *Id*.
44. *Id*.
45. *Id*.
46. *Id*.
47. *Id*.

Additional environmental concerns include "genetic . . . consequences for wild stocks, . . . coastal habitat alteration, effluent effects on habitat, and interactions with marine mammals and endangered species."[48]

Most of these harmful environmental effects derive from the inescapable fact that aquaculture and mariculture are intimately tied to water. Some of the most basic environmental concerns regarding aquaculture and mariculture are these industries' effects on water quality. It is on this aspect of environmental harm that the rest of this section will concentrate, beginning with the intertwining of federal and state regulatory authority over coastal mariculture.

B. State and Federal Jurisdiction Over Ocean Waters

As the EPA noted, "[n]o comprehensive regulatory framework exists for permitting aquaculture operations."[49] Instead, because most mariculture takes place in nearshore coastal waters, it is subject to a complex blend of state and federal regulation.

As a result of international law and presidential proclamations, the United States regulates the oceans out to two hundred miles from its coastlines in bands of decreasing sovereignty the farther out to sea one goes.[50] Closest to shore, and therefore of most relevance to mariculture, is the U.S.'s territorial sea, stretching from the coast out to twelve miles from shore.[51] Under international law, the United

48. *See* OFFICE OF WATER, EPA, *supra* note 10, at 21.

49. *Id*.

50. *See* United Nations Convention on the Law of the Sea [hereinafter UNCLOS III], Dec. 10, 1982 (entered into force Nov. 16, 1994), arts. 2.1, 2.2, 3 (allowing signatory nations to claim a 120 mile wide territorial sea); *id.* art. 33 (allowing signatory nations to claim a contiguous zone out to twenty-four miles from shore); *id.* arts. 55-75 (allowing signatory nations to claim a 200-mile-wide Exclusive Economic Zone (EEZ)). While the United States has not ratified UNCLOS III, it regards the provisions of that treaty as customary international law and claims each of these zones for itself through customary international law. President Reagan proclaimed a 200-mile-wide EEZ for the United States in 1983 and claimed a twelve-mile-wide territorial sea in 1988. Exclusive Economic Zone of the United States of America, Proclamation No. 5030, 48 Fed. Reg. 10,605 (Mar. 10, 1983); Territorial Sea of the United States of America, Proclamation No. 5928, 54 Fed. Reg. 777 (Dec. 27, 1988). President Clinton proclaimed a twenty-four-mile-wide contiguous zone for the United States in 1999. Contiguous Zone of the United States, Proclamation No. 7219, 64 Fed. Reg. 48,701 (Aug. 2, 1999).

51. *See* UNCLOS III, arts. 2.1, 2.2, 3. In 1988, President Reagan extended the U.S.'s territorial sea to twelve miles. Territorial Sea of the United States of America, Proclamation No.

States has complete sovereignty over the waters, airspace, seabed, and subsoil within this twelve-mile band, subject to ships' right of innocent passage.[52]

Within the United States, however, federal law divides control over this twelve-mile territorial sea between the federal and coastal state governments. Under the Submerged Lands Act of 1953,[53] coastal states received title to the lands beneath and control over coastal waters at least three miles out to sea,[54] subject to the federal government's paramount rights to regulate for "commerce, navigation, national defense, and international affairs . . . ."[55] Therefore, as a general rule, states regulate mariculture activities in the first three miles of coastal waters, and the federal government regulates mariculture activities more than three miles out to sea.

C. Coastal Zone Management and Mariculture

"Two-thirds of the world's largest cities are located on coasts and populations of coastal areas are growing faster than inland populations."[56] In the United States, about half the population lives in one of the 673 counties located entirely or partially within a coastal watershed.[57] To encourage coastal states to engage in planning to deal with the environmental consequences of these dense and growing coastal populations, Congress enacted the Coastal Zone Management Act of 1972 (CZMA).[58] The Act explicitly recognizes that

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5928, 54 Fed. Reg. 777 (Dec. 27, 1988).

52. UNCLOS III, arts 2.1, 2.2, 3, 17-25.

53. 43 U.S.C. §§ 1301-1303, 1311-1315 (1994).

54. *Id*. § 1301(a)(2). States such as Florida and Texas have historical claims to more ocean territory, and can press those claims against the United States. *Id*. §§ 1301(a)(2), 1312.

55. *Id*. § 1314(a).

56. BILIANA CICIN-SAIN & ROBERT W. KNECHT, INTERGRATED OCEAN AND COASTAL MANAGEMENT: CONCEPTS AND PRACTICES 15 (1998).

57. Thomas J. Culliton, *Population: Distribution, Density and Growth: National Picture*, *in* NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), STATE OF THE COAST REPORT (1998), *available at* http://state-of-coast.noaa.gov/bulletins/html/pop_01/pop.html (last visited July 30, 2001).

58. 16 U.S.C. §§ 1451-1465 (1994 & Supp. II 1996). As Congress declared:

> The key to more effective protection and use of the land and water resources of the coastal zone is to encourage the states to exercise their full authority over the lands and waters in the coastal zone by assisting the states, in cooperation with [f]ederal and local governments and other vitally affected interests, in developing land and water use

"harvesting of fish, shellfish, and other living marine resources" is one factor that contributed to "the loss of living marine resources, wildlife, nutrient-rich areas, permanent and adverse changes to ecological systems, decreasing open space for public use, and shoreline erosion."[59]

The CZMA applies only to the relatively narrow "coastal zone."[60] For state programs that regulate this zone, the CZMA provides federal management program development grants and administrative grants.[61] In order for a state to qualify for such grants, however, it must submit a coastal zone management program to the Secretary of Commerce, acting through NOAA, for approval, following the sixteen specified requirements.[62] In order to be approved, moreover, the state program must contain nine elements.[63]

While the CZMA does not explicitly mention aquaculture or mariculture, it does enact a national policy to provide for "priority consideration being given to coastal-dependent uses"[64] and otherwise encourages states to regulate mariculture activities. For example, the state coastal management program must contain "[a] definition of what shall constitute permissible land uses and water uses within the coastal zone which have a direct and significant impact on the coastal

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> programs for the coastal zone, including unified policies, criteria, standards, methods, and processes for dealing with land and water use decisions of more than local significance.

Id. § 1451(i).

59. *Id.* § 1451(c).

60. *Id.* § 1453(1). Under the CZMA, the "coastal zone" is:

> the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends . . . seaward to the outer limit of State title and ownership under the Submerged Lands Act . . . . The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters, and to control those geographical areas which are likely to be affected by or vulnerable to sea level rise.

Id.

61. *Id.* §§ 1454, 1455.

62. *Id.* § 1455(d).

63. *Id.* § 1455(d)(2)(A)-(I).

64. *Id.* § 1452(2)(D).

waters"[65] and "[b]road guidelines on priorities of uses in particular areas, including specifically those uses of lowest priority."[66] In addition, the state management program must provide techniques "for control of land uses and water uses within the coastal zone," including:

> (A) State establishment of criteria and standards for local implementation, subject to administrative review and enforcement.
>
> (B) Direct State land and water use planning and regulation.
>
> (C) State administrative review for consistency with the management program of all development plans, projects, or land and water use regulations, including exceptions and variances thereto, proposed by any State or local authority or private developer, with power to approve or disapprove after public notice and an opportunity for hearings.[67]

As a practical matter, recent amendments to the CZMA resulted in aquaculture regulation receiving more state attention.[68] CZMA-related state regulatory projects included:

> development of aquaculture net-pen guidelines (Mississippi); impact of aquaculture on eutrophication of coastal bays (Maine); revision of aquaculture lease rules (Maine); development of a marine aquaculture management plan and

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65. *Id*. § 1455(d)(2)(B).
66. *Id*. § 1455(d)(2)(E).
67. *Id*. § 1455(d)(11).
68. *See* UNIV. OF CALIFORNIA, SAN DIEGO, *supra* note 11, at *Current Status of Aquaculture in NOAA: NOS*.

> The 1990 amendments encouraged states and territories to support comprehensive planning, conservation and management for living marine resources including aquaculture facilities. The 1996 amendments provided new authorization for states to use CZMA funds for: (1) the adoption of procedures and policies to evaluate and facilitate the siting of public and private aquaculture facilities in the coastal zone; (2) to enable States to formulate, administer, and implement strategic plans for marine aquaculture; and (3) to develop a coordinated process among State agencies to regulate and issue permits for aquaculture facilities in the coastal zone.

Id.

geographic information system (Rhode Island); and development and implementation of a marine aquaculture regulatory and leasing program (Virginia).[69]

D. The Federal Clean Water Act and Mariculture

Despite the conveyance to states of title to and regulatory control over the first three miles of ocean, the commerce exception in the Submerged Lands Act has kept the federal government involved in this coastal zone. The most prominent example of direct federal regulation of water quality is the Clean Water Act,[70] which creates a substantial federal framework for regulating aquaculture facilities that can affect water quality.

The Clean Water Act establishes a national goal "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[71] Its primary mechanism for achieving that goal is a general prohibition of any "discharge of any pollutant" except in accordance with the Act's permit programs.[72] The most general of these permit programs is the National Pollutant Discharge Elimination System (NPDES) permit program,[73] which gives the Administrator of the EPA initial authority to issue permits "for the discharge of any pollutant, or combination of pollutants," notwithstanding the general prohibition.[74] States are also entitled to acquire permit program authority from the EPA.[75]

The terms of NPDES permits for land based discharges are based on water quality standards and effluent limitations. Effluent limitations are technology-based, numeric or narrative "restriction[s] . . . on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or

69. *Id*.
70. 33 U.S.C. §§ 1251-1387 (1994).
71. *Id*. § 1251(a).
72. *Id*. § 1311(a).
73. *Id*. § 1342(a)(1).
74. *Id*.
75. *Id*. § 1342(b).

the ocean, including schedules of compliance."[76] The EPA received the initial and primary authority for establishing effluent limitations.[77] The states, in turn, received the initial authority to set water quality standards,[78] which describe the overall goal of water quality for a given body of water. In particular, water quality standards "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses."[79] Designated uses delineate what the state wants the water body to be used for. Such uses include: "public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes . . . ."[80] Water quality criteria create standards for water quality that will allow the water body to achieve the designated uses.[81] Overall, water quality standards must "protect the public health or welfare, enhance the quality of water and serve the purposes of" the Act.[82]

Discharges into the coastal waters—into the Act's territorial sea—are subject to another set of limitations as well. Under § 403 of the Clean Water Act, no NPDES permit "for a discharge into the territorial sea, the waters of the contiguous zone, or the oceans shall be issued, . . . except in compliance with . . . guidelines" that the EPA establishes pursuant to that section.[83] These guidelines, known as "ocean discharge criteria," are for "determining the degradation of the waters of the territorial seas, the contiguous zone, and the oceans."[84] The EPA promulgated ocean discharge criteria in 1980

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76. *Id*. § 1362(11).

77. *See id*. §§ 1311(b) (requiring the EPA to set various kinds of technology-based effluent limitations), 1311(e) (subjecting all point source discharges to the effluent limitations that the EPA establishes).

78. *Id*. § 1313(a).

79. *Id*. § 1313(c)(2)(A).

80. *Id*.

81. 40 C.F.R. § 122.44(d)(1)(vi)(A) (2000).

82. 33 U.S.C. § 1313(c)(2)(A) (1994).

83. *Id*. § 1343(a).

84. *Id*. § 1343(c). These guidelines are based on:

(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,

that have remained in place ever since.[85]

As noted, NPDES permits are required for "discharges of pollutants." "Discharge of a pollutant" is a defined term in the Clean Water Act, which "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 floating craft."[86] The Act defines "pollutant" very broadly to include nearly anything added to water, including heat.[87] Finally, a "point source" is:

> any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not

---

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.

85. 45 Fed. Reg. 65,942, 65,953 (Oct. 3, 1980), *codified at* 40 C.F.R. §§ 125.120 to 125.124 (2000). In early 2001, the EPA was prepared to propose new ocean discharge criteria for the first time since 1980. EPA, OCEAN DISCHARGE CRITERIA: REVISIONS TO THE OCEAN DISCHARGE CRITERIA REGULATIONS (2001), *available at* http://www.epa.gov/owow/oceans/protecting_oceans/cwa403rule.pdf. However, incoming President George W. Bush prevented publication of those proposed rules. *Id*. at 1 (citing President Bush's Regulatory Review Plan, 66 Fed. Reg. 7,701 (Jan. 24, 2001)); Office of Water, U.S. EPA, *Protecting Our Beaches, Oceans, and Coasts: Ocean Discharge Criteria*, *available at* http://www.epa.gov/owow/oceans/protecting_oceans/ (last revised Feb. 23, 2001). The EPA has since announced that it will go ahead and publish proposed new ocean discharge criteria, 66 Fed. Reg. 26,254, 26,257 (May 14, 2001), but, as of March 2002, no new proposed regulations have appeared. For a more comprehensive discussion of the proposed ocean discharge criteria and its importance for ocean water quality, see generally Robin Kundis Craig & Sarah Miller, *Ocean Discharge Criteria and Marine Protected Areas: Ocean Water Quality Protection Under the Clean Water Act*, 28:2 B.C. ENVTL. AFFAIRS L. REV. 1, 21-44 (2001).

86. 33. U.S.C. § 1362(12) (1994).

87. *Id*. § 1362(6).

> include agricultural stormwater discharges and return flows from irrigated agriculture.[88]

Although the prohibition on "discharge[s] . . . of a pollutant" applies to all zones of U.S. waters, including the oceans, the "navigable waters" are most relevant for aquaculture, comprising "the waters of the United States, including the territorial seas."[89] The Clean Water Act's "territorial seas," in turn, comprise the first three miles of coastal waters[90] where the states have primary regulatory authority under the Submerged Lands Act.

Production methods for aquaculture emphasize their close connection to larger aquatic systems. Sixty-three percent of aquaculture products produced in the United States are produced in ponds, fourteen percent in flow-through raceways or tanks, seven percent in prepared bottom facilities, seven percent in closed recirculation tanks, and four percent in cages and net pens.[91] Of these production methods, some situate the aquaculture "crop" directly in existing navigable waters. Others are land-based facilities removed from direct contact with navigable waters, but usually nevertheless dependent on them. The EPA distinguished these two types of facilities by regulation, referring to the former as "aquaculture projects" and the latter as "aquatic animal production facilities" (AAPFs).[92] In part because of these differences, the two types of aquaculture facilities are subject to different NPDES permitting

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88. *Id*. § 1362(14).

89. *Id*. § 1362(7).

90. *Id*. § 1362(8).

91. NAT'L AGRIC. STATISTICS SERV., USDA, *Method of Agricultural Production Used*, *in* 1998 CENSUS OF AQUACULTURE, *at* http://www.nass.usda.gov/census/census97/aquaculture/quickfacts/indexp3.htm (last visited Dec. 20, 2001).

92. Revisions to the National Pollutant Discharge Elimination System Program and Federal Antidegradation Policy in Support of Revisions to the Water Quality Planning and Management Regulation, 64 Fed. Reg. 46,058, 46,074 (Aug. 23, 1999).

> Although both types of operations produce aquatic livestock, aquatic animal production facilities differ from aquaculture projects. Aquaculture projects confine aquatic stock within jurisdictional waters of the United States. An aquatic animal production facility does not confine aquatic stock in jurisdictional waters of the United States. The aquatic area of confinement (e.g., manmade pond, raceway, etc.) may, however, discharge to jurisdictional waters of the United States.

Id.

requirements.

To encourage aquaculture projects, Congress included a special section in the Clean Water Act, § 318,[93] and made the general NPDES permit program subject to its provisions when aquaculture projects are involved.[94] Under § 318, "[t]he Administrator is authorized . . . to permit the discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project under Federal or State supervision pursuant to" the NPDES permit program.[95] States may acquire aquaculture permitting authority,[96] but "[t]he Administrator shall by regulation establish any procedures and guidelines which the Administrator deems necessary to carry out" aquaculture permitting.[97]

The EPA's Clean Water Act regulations define an "aquaculture project" as "a defined managed water area which uses discharges of pollutants into that designated area for the maintenance or production of harvestable freshwater, estuarine, or marine plants or animals."[98] The "designated project area" consists of:

> the portions of the waters of the United States within which the permittee or permit applicant plans to confine the cultivated species, using a method or plan of operation (including, but not limited to, physical confinement) which, on the basis of reliable scientific evidence, is expected to ensure that specific individual organisms comprising an aquaculture crop will enjoy increased growth attributable to the discharge of pollutants, and be harvested within a defined geographic area.[99]

The EPA's main concern, therefore, is to ensure that aquaculture facilities are sufficiently confined and productive to justify intentional pollution of the navigable waters.

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93. 33 U.S.C. § 1328 (1994).

94. *See id*. § 1342(a)(1) (noting that the Administrator of the EPA may issue NPDES permits "[e]xcept as provided in section[] 1328").

95. *Id*. § 1328(a).

96. *Id* § 1328(c).

97. *Id.*

98. Aquaculture Projects, 40 C.F.R. § 122.25(b)(1) (2000).

99. *Id*. § 122.25(b)(2).

Approved aquaculture projects are a more limited class of aquaculture facilities than they might first appear.

> The legislative history is clear that "aquaculture," as the term is used in section 318 of the Act, is intended to refer to controlled conditions at an approved aquaculture project, i.e., innovative reuse of effluent discharges from municipal and/or industrial sources. In 1977, EPA explained that aquaculture projects were viewed as one way to put existing pollution to productive use.[100]

The aquaculture project statute and regulations are thus intended to authorize, on a selective basis, controlled discharges that would otherwise be unlawful under the Act. This authorization is done in a carefully supervised manner, in order to determine the existing and potential feasibility of using pollutants to grow aquatic organisms that can be harvested and used beneficially and to encourage such projects, while at the same time protecting the other beneficial uses of the waters.[101] In other words, in addition to being located in the navigable waters, approved aquaculture projects must involve some element of recycling wastes.

When aquaculture projects qualify under § 318, the Clean Water Act and EPA's regulations promote *allowing* the discharges that make such projects possible. As part of this encouragement, for example, aquaculture projects are currently exempt from the technology-based effluent limitations that govern most NPDES permits, "except with respect to toxic pollutants."[102] Nevertheless, even aquaculture projects could involve the unintended pollution of downstream waters by aquaculture wastes and by-products. To deal with this *unintended* pollution, the EPA has set standards for approving aquaculture projects.[103]

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100. Revisions to the Water Quality Planning and Management Regulation and Revisions to the National Pollutant Discharge Elimination System Program in Support of Revisions to the Water Quality Planning and Management Regulation, 65 Fed. Reg. 43,586, 43,649 (July 13, 2000) (citing 42 Fed. Reg. 25,478 (May 17, 1977)).

101. *Id*. (citing 40 C.F.R. § 125.15(b) (proposed at 43 Fed. Reg. 37,132, Aug. 21, 1973)).

102. 40 C.F.R. § 125.10(c) (2000).

103. *Id*. § 125.11(a). Under these standards:

Thus, although the EPA's regulations focus primarily on discharges *into* the aquaculture project, they also forbid aquaculture projects from interfering with downstream water quality and from violating existing standards and limitations for the water body in which the project is located. In addition, aquaculture projects located in the territorial sea, contiguous zone, or ocean must comply with the ocean discharge criteria.[104]

In contrast to aquaculture projects, any aquaculture facility that does "not use discharges of wastes from a separate industrial or municipal point source for the maintenance, propagation and/or production of harvestable freshwater, marine, or estuarine organisms" is an aquatic animal production facility (AAPF) potentially subject to

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> No NPDES permit shall be issued to an aquaculture project unless:
>
> (1) The Director determines that the aquaculture project:
>
> (i) Is intended by the project operator to produce a crop which has significant direct or indirect commercial value (or is intended to be operated for research into possible production of such a crop); and
>
> (ii) Does not occupy a designated project area which is larger than can be economically operated for the crop under cultivation or than is necessary for research purposes.
>
> (2) The applicant has demonstrated, to the satisfaction of the Director, that the use of the pollutant to be discharged to the aquaculture project will result in an increased harvest of organisms under culture over what would naturally occur in the area;
>
> (3) The applicant has demonstrated, to the satisfaction of the Director, that if the species to be cultivated in the aquaculture project is not indigenous to the immediate geographical area, there will be minimal adverse effects on the flora and fauna indigenous to the area, and the total commercial value of the introduced species is at least equal to that of the displaced or affected indigenous flora and fauna;
>
> (4) The Director determines that the crop will not have significant potential for human health hazards resulting from its consumption;
>
> (5) The Director determines that migration of pollutants from the designated area to water outside of the aquaculture project will not cause or contribute to a violation of water quality standards or a violation of the applicable standards and limitations applicable to the supplier of the pollutant that would govern if the aquaculture project were itself a point source. The approval of an aquaculture project shall not result in the enlargement of a pre-existing mixing zone area beyond what had been designated by the State for the original discharge.

Id.

104. *Id*. § 125.11(c); *see also* 33 U.S.C. § 1343 (1994) (setting out the requirements for ocean discharge criteria).

the normal NPDES permit requirements.[105] Although AAPFs generally are not situated directly in the navigable waters, many AAPFs are located near navigable waters for convenience, and through their waste streams they "contribute nutrients to environmentally sensitive areas in estuaries, rivers, lakes, and streams throughout the country."[106] Moreover, when sufficiently concentrated, fish farms and other aquaculture operations can function as "'aquatic feedlots' similar to other forms of intensive animal production that can produce large quantities of wastes. These wastes are released directly into waterbodies and have the potential to contribute to nutrient overloading."[107]

In recognition of this congruence with other types of intensive animal farming, the EPA regulates AAPFs in a manner similar to how it regulates more traditional farming animal feeding operations (AFOs).[108] Indeed, the EPA lumped the two together as one of the largest remaining water quality problems to solve:

> In some areas, pollutant contributions from small unregulated (by NPDES) animal production sources (terrestrial and aquatic) are the primary cause of impairment in some water segments. As indicated in the 1996 Report to Congress . . ., agriculture, including both animals and cropland, is the leading source of water quality impairment in rivers and lakes. Based on data collected by the States and Territories, EPA estimated

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105. Revisions to the Water Quality Planning and Management Regulation and Revisions to the National Pollutant Discharge Elimination System Program in Support of Revisions to the Water Quality Planning and Management Regulation, 65 Fed. Reg. 43,586, 43,649 (July 13, 2000).

106. OFFICE OF WATER, EPA, EFFLUENT GUILDLINES: EPA EXPANDS FOCUS ON NUTRIENT POLLUTION (Feb. 2000), *at* http://www.epa.gov/ost/guide/aquaculture/factsheet.html (last revised Nov. 20, 2001).

107. OFFICE OF WATER, EPA, *New Report from the Environmental Defense Fund on Environmental Effects of Aquaculture*, *in* COASTLINES: INFORMATION ABOUT ESTUARIES AND NEAR COASTAL WATERS, *at* http://www.epa.gov/OWOW/estuaries/coastlines/summer98/aquaculture.html (last revised Sept. 2, 1998).

108. For further discussions of AFOs, CAFOs, and water quality, see generally Kristen E. Molnow, Concerned Area Residents for the Environment v. Southview Farm*: Just What Is a Concentrated Animal Feeding Operation Under the Clean Water Act?*, 5 ALB. L. ENVTL. OUTLOOK 11 (2000); Gregory W. Blount et al., *The New Nonpoint Source Battleground: Concentrated Animal Feeding Operations*, 5 ALB. L. ENVTL. OUTLOOK 27 (2000).

> that, of the waters assessed, 25 percent of the impaired river miles, 19 percent of the impaired lake acres, and 10 percent of the impaired estuarine square miles are polluted due to agricultural nonpoint sources of pollutants (EPA, 1996).[109]

Specifically, AAPFs "cause significant adverse impacts on water quality," including "oxygen depletion in surrounding waters, degradation of benthic (bottom) ecosystems, and increases in the severity of toxic algae blooms."[110] The type and severity of the pollution can vary by type of AAPF. "Pond and tank systems, for example, often discharge pulses of highly concentrated waste discharges during cleaning and harvesting," whereas "[c]atfish ponds . . . release effluents containing high concentrations of nutrients, often at concentrations exceeding water quality limits set by EPA and state governments."[111]

Discharges of pollutants from concentrated AAPFs (CAAPFs) and concentrated AFOs (CAFOs) are both explicitly subject to the NPDES permit requirement,[112] and the EPA procedurally handles CAAPFs like CAFOs, requiring them to submit the same form of permitting application[113] and requiring parallel information.[114] A CAAPF, for purposes of NPDES permitting, is a "hatchery, fish farm, or other facility" that either meets certain regulatory criteria or is qualified by the EPA as a CAAPF on a case-by-case basis.[115] Under the regulatory criteria, an aquaculture facility qualifies as a CAAPF "if it contains, grows, or holds aquatic animals" in either of the following categories:

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109. Revisions to the National Pollutant Discharge Elimination System Program and Federal Antidegradation Policy in Support of Revisions to the Water Quality Planning and Management Regulation, 64 Fed. Reg. 46,058, 46,075 (Aug. 23, 1999).

110. *Id*. at 46,075.

111. *Id*. (citations omitted).

112. 40 C.F.R. §§ 122.3(e), 122.23(a), 122.24(a) (2000). CAFOs are also explicitly mentioned in the Clean Water Act's definition of "point source." 33 U.S.C. § 1362(12) (1994).

113. 40 C.F.R. § 122.21(a)(2)(C) (2000).

114. *Compare* 40 C.F.R. § 122.21(i)(2) (required CAAPF information) *with* 40 C.F.R. § 122.21(i)(1) (required CAFO information).

115. 40 C.F.R. § 122.24(b).

(a) Cold water fish species or other cold water aquatic animals in ponds, raceways, or other similar structures which discharge at least 30 days per year but does not include:

(1) Facilities which produce less than 9,090 harvest weight kilograms (approximately 20,000 pounds) of aquatic animals per year; and

(2) Facilities which feed less than 2,272 kilograms (approximately 5,000 pounds of food during the calendar month of maximum feeding.

(b) Warm water fish species or other warm water aquatic animals in ponds, raceways, or other similar structures which discharge at least 30 days per year, but does not include:

(1) Closed ponds which discharge only during periods of excess runoff; or

(2) Facilities which produce less than 45,454 harvest weight kilograms (approximately 100,000 pounds) of aquatic animals per year.[116]

Cold water fish include trout and salmon, while warm water fish include catfish, sunfish, and minnows.[117]

In general, only the larger aquaculture facilities meet the regulatory criteria to qualify as CAAPFs. On a case-by-case basis, however, a facility may also qualify as a CAAPF if "it is a significant contributor of pollution to waters of the United States," based on the following factors:

(i) The location and quality of the receiving waters of the United States;

(ii) The holding, feeding, and production capacities of the facility;

116. 40 C.F.R. pt. 122, app. C (2000).
117. *Id*.

(iii) The quantity and nature of the pollutants reaching waters of the United States; and

(iv) Other relevant factors.[118]

Thus, current regulations allow the EPA to require NPDES permits for any aquaculture facility that is likely to significantly affect water quality.

In the last decade, the EPA worked to strengthen its regulation of aquaculture facilities in order to better protect water quality. In 1999, the EPA specifically asserted its authority under the Clean Water Act "to designate animal feeding operations (AFOs) and aquatic animal production facilities (AAPFs) as sources subject to NPDES program requirements on a case-by-case basis."[119] Previously, only states could designate which AFOs and AAPFs constituted CAFOs and CAAPFs that are subject to the permit requirement.[120] While the EPA later withdrew the proposed amendments regarding designation of CAAPFs,[121] it emphasized that "[m]ost commercial fish husbandry that the layperson refers to as 'aquaculture,' including fish farms located in waters of the U.S., is subject to NPDES regulation under the rubric 'concentrated aquatic animal production facility.'"[122]

More significantly, over the next three years the EPA intends to promulgate effluent limitations for aquaculture projects, subjecting them for the first time to technology-based standards to protect water quality.[123] In 1974, the EPA decided "not to issue final national

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118. 40 C.F.R. § 122.24(c)(1) (2000).

119. Revisions to the National Pollutant Discharge Elimination System Program and Federal Antidegradation Policy in Support of Revisions to the Water Quality Planning and Management Regulation, 64 Fed. Reg. 46,058, 46,074 (Aug. 23, 1999).

120. *See id.*

121. Revisions to the Water Quality Planning and Management Regulation and Revisions to the National Pollutant Discharge Elimination System Program in Support of Revisions to the Water Quality Planning and Management Regulation, 65 Fed. Reg. 43,586, 43,649 (July 13, 2000).

122. *Id*.

123. *See* 65 Fed. Reg. 23,582, 23,582 (Apr. 24, 2000).

> EPA is focusing new efforts to help reduce nutrient loadings from commercial aquaculture and industrial operations nationwide. Currently, there are no federal technology-based standards for aquaculture. This action is a new effort to develop pollutant controls in the form of nationally applicable discharge standards (known as

effluent limitations guidelines and standards" for aquaculture facilities;[124] however, "[g]iven the current growth of the aquaculture industry, and the inconsistent state regulatory oversight, EPA has [now] decided to examine technologies currently available for the control of pollutants, primarily nutrients, from land based and marine environment aquaculture operations."[125] In addition, "[n]ew national standards for aquaculture will assist the 43 states that are delegated by EPA to administer the NPDES . . . permitting program."[126] Noting that some aquaculture facilities already employ technological improvements in wastewater treatment, such as reducing their nutrient pollution, the EPA hopes that more aquaculture facilities will "employ these technologies to reduce pollutant discharge loadings to surface waters and, in some cases, water quality impairment in portions of the U.S."[127]

III. THE OTHER SIDE: REGULATING WATER QUALITY TO PROTECT AQUACULTURE AND MARICULTURE

As the previous discussion makes clear, despite the general encouragement of aquaculture and mariculture from the federal government, federal agencies also focused much attention on regulating aquaculture facilities to protect downstream water quality. If aquaculture and mariculture are to achieve high levels of sustainable production, however, they must also be protected from upstream water pollution. For mariculture projects in the coastal zone, moreover, such protection requires a better approach to regulating land-based pollution of the oceans, especially nonpoint source water pollution.

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effluent limitations guidelines and standards) for commercial and public aquaculture operations.

Id. To further this purpose, the EPA is planning to issue proposed rules in June 2002 and final rules in June 2004.

124. OFFICE OF WATER, EPA, EFFLUENT GUILDLINES: EPA EXPANDS FOCUS ON NUTRIENT POLLUTION (Feb. 2000), *at* http://www.epa.gov/ost/guide/aquaculture/factsheet.html (last revised Nov. 20, 2001).

125. *Id*.

126. *Id*.

127. *Id*.

A. Coastal Zone Management and Promotion of Mariculture

Most mariculture, like the mollusk cultivation in North Carolina, occurs in coastal waters. However, the coasts are also extraordinarily popular areas with Americans. About half of the U.S.'s population lives on the coast,[128] and large coastal populations are primarily responsible for most of the problems that interfere with the sustainability of coastal areas—including ocean water quality.

Coastal zones are home to several kinds of productive and diverse ecosystems that human populations threaten through development, pollution, and overuse. Some of the most vital areas of the coastal zone for mariculture are coastal wetlands, which include estuaries, salt and tidal marshes, and mud flats.[129] All of these wetlands provide critical habitat and ecosystem services,[130] but estuaries are particularly important. "An estuary is the area in which the ocean tides meet a river current, with the river's freshwater diluting the saltwater . . . ."[131] "[E]stuaries provide habitat for more than 75% of America's commercial fish catch, and for 80-90% of the recreational fish catch. Estuarine-dependent fisheries are among the most valuable within regions and across the nation, worth more than $1.9 billion in

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128. OFFICE OF WATER, EPA, ABOUT ESTUARIES: WHY PROTECT ESTUARIES?, *at* http://www.epa.gov/owow/estuaries/about1.htm (last revised June 22, 2001).

129. THOMAS E. SVARNEY & PATRICIA BARNES-SVARNEY, THE HANDY OCEAN ANSWER BOOK 360 (2000). Salt marshes "are large, flat areas of land protected from the wave action of the tides, but still inundated with brackish to salty tidal waters . . . ." *Id*. at 361. Mud flats, in turn, "are relatively flat areas covered with very fine-grained silt (in a sheltered estuary), and alternately covered and uncovered by the tide," while "the tidal marshes are found on the landward side of the salt marshes and mud flats." *Id*.

130. *Id*. at 362-64.

> Salt marshes are thought to be some of the most dynamic and rigorous environments because of conditions set up by the tides. As the tides move in and out of the marsh, the animals and plants have to shift from being terrestrial (land) to oceanic organisms in a few short hours. During this time, the water levels, salinity, temperatures, and exposure to air vary greatly—making it a challenge for the organisms that live here. To add to the pressure, there are also periodic tropical storms and spring and summer floods that must be endured.

Id. (noting that coastal mud flats support sessile (anchored) plants, mollusks such as clams, and crustaceans such as crabs, while the more protected tidal marshes provide habitat for numerous kinds of shorebirds and mammals).

131. *Id*. at 361. "Estuaries and the lands surrounding them are places of transition from land to sea, and from fresh to salt water." OFFICE OF WATER, EPA, *supra* note 128.

1990, excluding Alaska."[132] In addition, "[t]he vegetation in estuaries works as a natural filter: Grasses, seaweeds, and other plant life slow fast-flowing waters and remove certain pollutants from them as the tide rises and falls."[133] Finally, wetlands vegetation can protect coastal areas from erosion "by slowing runoff and by evenly distributing the energy in runoff."[134] All of these functions of estuaries help make them productive areas for certain types of mariculture as well as help protect deeper ocean water, and deeper water mariculture facilities, from upstream water pollution.

Unfortunately, upstream water pollution is currently overwhelming the dwindling coastal wetlands' ability to keep coastal waters clean. In January 2001, the EPA rated the overall national coastal condition as being somewhere between "poor" and "fair."[135] Approximately 58% of the Nation's coastline miles are polluted enough that they are under fish consumption advisories, particularly along the Gulf Coast (100%) and Atlantic Coast (62%).[136] Although regional variations exist, overall, sediments, benthic living resources, eutrophic (oxygen-deprived) conditions, and coastal wetland loss are "poor,"[137] creating sub-standard growing conditions for sediment-dependent mollusks such as oysters. In addition, coastal wetland loss received a "poor" rating because 50% of such wetlands were lost in the United States between 1780 and 1980,[138] severely reducing potential mariculture growing grounds and the ability of coastal areas to self-clean. Qualitatively:

> About 56% of estuaries in the continental United States are in good condition for supporting aquatic life use (animal and plant communities) and human uses (such as drinking water, agriculture, swimming, and boating) . . . . About 34% of the

132. *See id.*
133. *See* SVARNEY & BARNES-SVARNEY, *supra* note 129, at 362.
134. *Id.*
135. OFFICE OF WATER, EPA, DRAFT: CLEAN WATER ACTION PLAN: NAT'L COASTAL CONDITION REP. x (Jan. 12, 2001), *at* http://www.epa.gov/owow/oceans/cwap/downloads.html. The Southeast coast is in the best shape, followed by the West; the Northeast and Gulf coasts are in the poorest condition. *Id.*
136. *Id.* at xv.
137. *Id.* at x.
138. *Id.* at xiii.

> estuarine area shows evidence of impaired aquatic life use and 33% of the area shows evidence of impaired human use based on available data. In fact, 23% of estuarine area in the continental United States is degraded for both aquatic life and human uses.[139]

Leading estuary pollutants include pathogens such as bacteria, oxygen-depleting substances, metals, nutrients, thermal modifications, PCBs, and toxic organic compounds. These pollutants come primarily from municipal point sources, urban runoff and storm sewers, atmospheric deposition, industrial discharges, agriculture, land waste disposal, and combined sewer overflows.[140] In other words, most of the stresses to this countries' coastal zones come from their human populations.

If current projections are correct, population pressures in the coastal zones will impede sustainable development of these areas for decades to come. In its 1998 *State of the Coast Report*, the National Oceanic and Atmospheric Administration (NOAA) noted that the coastal zone—"comprising 17% of the continuous U.S. land area—[was] home to more than 53% of the nation's population," and the coastal population "is increasing by 3,600 people per day, giving a projected total increase of 27 million people between now and 2015."[141] "This rate of growth is faster than that for the nation as a whole . . . ."[142] "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."[143] In addition, "[d]evelopment pressures have resulted in substantial physical changes along many areas of the coastal zone. Coastal wetlands continue to be lost to residential and

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139. *Id*.

140. *Id*. at xvi.

141. Thomas J. Culliton, *Population: Distribution, Density, and Growth*, NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/pop_01/pop.html (visited July 30, 2001); *see also* OFFICE OF WATER, EPA, DRAFT: CLEAN WATER ACTION PLAN: NATIONAL COASTAL CONDITION REPORT 3 (Jan. 12, 2001), *at* http://www.epa.gov/owow/ oceans/cwap/downloads.html (giving the same projections).

142. *See* OFFICE OF WATER, EPA, *supra* note 135, at 3.

143. *Id*. at 4.

commercial development, while the quantity and timing of freshwater flow, critical to river and estuarine function, continue to be altered."[144]

The CZMA remains the most comprehensive coastal planning program,[145] and, as of August 2001, only Illinois still lacks a program for its small section of Great Lakes coast.[146] However, each state's and territory's participation in such programs varies considerably,[147] and efforts to include the ocean waters and land activities within these programs are a relatively recent development.[148] Nevertheless, although baseline data are largely missing, "it is clear that the CZMA program has, in thousands of instances around the U.S. shoreline, prevented inappropriate coastal development, fostered public access to the coast, served to protect fragile coastal resources such as wetlands, and protected the public from coastal hazards."[149]

States and territories with approved CZMA programs respond to population pressure by enacting policies that give priority in coastal development to water-dependent uses, and today such policies "cover 97% of the U.S. shoreline."[150] Such priority requirements favor mariculture facilities over less water-dependent uses of the coastal zone and help to reduce the pressures on the coastal zone from non-water-dependent uses.

Nevertheless, new threats to American coastal populations are emerging, particularly from marine infectious agents. Such problems are typical of degraded coastal areas.[151] Fifty-six states and territories

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144. *Id*.

145. *See generally* William C. Millhouser et al., *Managing Coastal Resources*, NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/crm_13/crm.html (last visited July 30, 2001).

146. BILIANA CICIN-SAIN & ROBERT W. KNECHT, THE FUTURE OF U.S. OCEAN POLICY: CHOICES FOR THE NEW CENTURY 125 (2000).

147. *See generally* Millhouser et al., *supra* note 145.

148. BILIANA CICIN-SAIN & ROBERT W. KNECHT, INTEGRATED OCEAN AND COASTAL MANAGEMENT: CONCEPTS AND PRACTICES 273 (1998); *see also* Millhouser et al., *supra* note 145 (noting that the four primary areas of interest to coastal states are preservation of wetlands, coastal hazards, public access, and coastal development).

149. CICIN-SAIN & KNECHT, *supra* note 149, at 127.

150. Kenneth Wlaker & Matt Arnn, *Preserving Waterfronts for Water-Dependent Uses*, *in* NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/wdu_11/wdu.html (last visited July 30, 2001).

151. COLIN WOODARD, OCEAN'S END: TRAVELS THROUGH ENDANGERED SEAS 23 (2000). In the Black Sea, for example, cholera contaminations killed several people and rendered

maintain water quality standards for bacteria, and the coastal states and territories apply such standards to their marine waters.[152] Even so, 33% of the nation's beaches "had an advisory and/or closing in effect at least once during 1998 . . . ."[153] "The most frequent sources of disease-causing micro-organisms (pathogens) are sewage overflows, polluted storm water runoff, sewage treatment plant malfunctions, boating wastes and malfunctioning septic systems."[154]

Though the United States possesses one of the most sophisticated legal frameworks for the management of ocean and coastal resources,[155] problems remain in sustainably managing the coastal zone and hence in ensuring sustainable mariculture. Sustainable mariculture is intimately tied to sustainable development of the U.S.'s coastal zones. Further development requires integrated management of both land and water resources and increased coordination between all levels of government, particularly given the projected population increases.

B. Ocean Pollution, Marine Water Quality Regulation, and Mariculture

The popular image of marine pollution is an ocean-based oil spill, such as the 1989 *Exxon Valdez* disaster off the coast of Alaska. Carried into state and federal legislatures, however, this image undermines the U.S.'s ability to sustainably maintain ocean water quality, because the most important sources of marine pollution are not ocean-based. "Land-based sources contribute 70 per cent of marine pollution, while maritime transport and dumping-at-sea activities contribute 10 percent each."[156] Oil pollution is a good example of the land-sea source split in marine pollution: in the late

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hundreds of others ill, and "Russian scientists recorded bacterial counts ten or twenty times the normal level." *Id.*

152. OFFICE OF WATER, EPA, BACTERIAL WATER QUALITY STANDARDS FOR RECREATIONAL WATERS (FRESHWATER AND MARINE WATERS), *at* http://www.epa.gov/ost/beaches/local/sum2.html (last updated June 14, 2001).

153. OFFICE OF WATER, EPA, *supra* note 135, at xvii.

154. OFFICE OF WATER, EPA, THE BEACH PROGRAM: INTRODUCTION, *at* http://www.epa.gov/ost/beaches/2000/introduction.html (last revised June 14, 2001).

155. CICIN-SAIN & KNECHT, *supra* note 148, at 274.

156. SVARNEY & BARNES-SVARNEY, *supra* note 129, at 431.

1990s, "the world's oceans receive[d] about 3.25 million tons of oil each year—with the majority of oil coming from street runoff along the coasts rather than tanker spills."[157]

Overall, by weight, discharges and runoff from land account for 44% of marine pollution; airborne land emissions for 33%; accidental spills and shipping for 12%; ocean dumping for 10%; and offshore oil and gas drilling and mining for 1%.[158] Runoff from land sources—known as *nonpoint source pollution*[159]—carries to the oceans "[e]xcess fertilizers, herbicides, and insecticides from agricultural lands and residential areas;" "toxic chemicals from urban runoff and energy production;" "[s]ediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;" "[s]alt from irrigation practices and acid drainage from abandoned mines;" and "[b]acteria and nutrients from livestock, pet wastes, and faulty septic systems . . . ."[160] Two of the three leading sources of water quality impairment for estuaries, for example, are urban runoff and agricultural runoff.[161]

Besides directly polluting the ocean, runoff is associated with increased numbers of Harmful Algal Blooms (HABs).[162] For example, two types of single-celled marine algae known as dinoflagellates, *Gonyaulax* and *Gymnodium*, "multiply when there is a profusion of nitrogen and phosphorus [as from fertilizer runoff from land-based agriculture], warm temperatures, and little competition."[163] During a "bloom," these microscopic plants cause a "red tide," producing neurotoxins that shellfish accumulate when they eat the algae, rendering them unfit for human consumption.[164] In this respect, HABs directly interfere with sustainable mariculture of

157. *Id*.

158. *Id*. at 433.

159. OFFICE OF WATER, EPA, WHAT IS NONPOINT SOURCE (NPS) POLLUTION? QUESTIONS AND ANSWERS, *at* http://www.epa.gov/owow/nps/qa.html (last revised Dec. 30, 1977).

160. *Id.*

161. OFFICE OF WATER, EPA, POINTER NO. 1: NONPOINT SOURCES OF POLLUTION: THE NATION'S LARGEST WATER QUALITY PROBLEM, *at* http://www.epa.gov/OWOW/nps/facts/point1.htm (last revised Apr. 10, 2001). The third leading source is municipal point sources, such as sewer systems. *Id*.

162. SVARNEY & BARNES-SVARNEY, *supra* note 129, at 433.

163. *Id*.

164. *Id*. at 444.

oysters and other shellfish. HABs also create marine dead zones, more scientifically known as eutrophic zones. Algae blooms often use up all of the dissolved oxygen in a given area of the ocean,[165] rendering that area unable to support life. The largest eutrophic zone in the United States, occupying 7000 square miles, recurs every spring and summer in the Gulf of Mexico off the mouth of the Mississippi River, causing massive fish kills.[166]

Under the Clean Water Act, the federal government and the states exercise fairly strong and effective control over readily-identifiable industrial, municipal, and ship-based sources of marine pollution. For example, several sections of the Clean Water Act are devoted to federal grants and loans for construction of publicly-owned sewage treatment works[167] that operate pursuant to NPDES permits like any other point source.[168] Largely as a result of these provisions, wastewater treatment served almost 81% of this country's population by 1993.[169]

More generally, as noted, under the NPDES permit program, all discharges of pollutants must have a Clean Water Act permit.[170] "Discharge of a pollutant" encompasses almost all "point source" discharges—discharges from "any discernible, confined, and discrete conveyance"—into the coastal navigable waters, the territorial sea, the contiguous zone, or the ocean.[171] Thus, the NPDES permit program regulates upstream point sources that discharge pollutants that could interfere with downstream mariculture projects.

However, the NPDES program does not cover discharges of

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165. *Id*.

166. WOODWARD, *supra* note 151, at 102.

167. 33 U.S.C. §§ 1281-1299 (1994).

168. *See* 33 U.S.C. § 1342(a) (1994). States can acquire—and most have acquired—authority to issue permits, but state-issued permits must still comply with the federal requirements. *See also* Office of Water, EPA, *State Program Status*, *at* http://cfpub.epa.gov/npdes/statestats.cfm?program_id=12 (last modified Mar. 20, 2001).

169. United Nations Commission on Sustainable Development, *Agenda 21, Chapter 17, United States of America: Review of Progress Made Since the United Nations Conference on Environment and Development*, United Nations Comm'n on Sustainable Development, 5th Sess., Agenda Item 21, ch. 17, *available at* http://www.un.org/esa/earthsummit/usa-cp.htm (last revised Nov. 1, 1997).

170. 33 U.S.C. § 1342(a)(1) (1994).

171. *Id*. § 1362(12)(14)(7). The Act defines "pollutant" very broadly, covering almost anything added to water, including heat. *Id*. § 1362(6).

pollutants from "vessel[s] or other floating craft" in the contiguous zone or the ocean.[172] Nevertheless, a plethora of federal statutes regulate and punish point sources of marine pollution that the Clean Water Act's NPDES program does not reach.[173]

In addition, the NPDES program does not apply to nonpoint sources of pollution. In 1987, Congress amended the Clean Water Act to add nonpoint source management program provisions,[174] requiring states to submit a nonpoint source management program to the EPA Administrator for approval.[175] The federal government supplies funding and technical assistance to the states to help with their nonpoint source programs,[176] but the program imposes no

172. *Id*. § 1362(12)(B).

173. Under the Clean Water Act, the EPA established "Federal standards of performance for marine sanitation devices . . . to prevent the discharge of untreated or inadequately treated sewage" from vessels. *Id*. § 1322(b)(1). The ocean dumping provisions of the 1972 Marine Protection, Research and Sanctuaries Act, 33 U.S.C. §§ 1401-1445 (1994), implementing the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Material, prohibit the dumping of any material into the oceans without a permit and regulate incineration of wastes at sea. Moreover, effective January 1, 1992, the Ocean Dumping Ban Act of 1988 prohibited dumping of sewage sludge and industrial waste into the oceans. 33 U.S.C. §§ 1414b-1414c (1994). In December 1987, the Senate unanimously approved Annex V (Regulations for the Prevention of Pollution by Garbage from Ships) of the International Convention for the Prevention of Pollution from Ships (MARPOL), and Congress enacted the Marine Plastic Pollution Research and Control Act of 1987 to implement its provisions. 33 U.S.C. §§ 1901-1912 (1994). The Deepwater Ports Act of 1974, 33 U.S.C. §§ 1501-1524 (1994) establishes licensing requirements for human-made ports outside the three-mile limit, while the Ports and Waterways Safety Act, as amended by the Port and Tanker Safety Act of 1978, 33 U.S.C. §§ 1221-1232 (1994), imposes vessel construction requirements on cargo vessels that carry oil or hazardous substances, and gives the Coast Guard authority to control vessel movement in ports and other hazardous areas.

Cleanup liability statutes are particularly effective. Vessels and other sources that discharge non-petroleum hazardous or toxic products into the ocean are liable for the cleanup costs under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, 42 U.S.C. §§ 9601-9675 (1994); *id.* § 9607. In 1990, in response to the *Exxon Valdez* oil spill, Congress passed the Oil Pollution Act (OPA), 33 U.S.C. §§ 2701-2761 (1994), which imposes cleanup and damage liability on responsible parties, including vessels, that release oil "into or upon the navigable waters or adjoining shorelines or the exclusive economic zone . . . ." *Id*. § 2702(a). Both CERCLA and the OPA allow states and the federal government to recover compensation from the responsible party for damages to natural resources. 33 U.S.C. §§ 2701(20), 2702(b)(2)(A), 2706(d) (1994); 42 U.S.C. § 9607(f) (1994). Between 1990, when Congress enacted the OPA, and 1993, discharges of oil into the nation's coastal waters dropped from 13.91 metric tons per year to only 1.54 metric tons. *See supra* note 169.

174. 33 U.S.C. § 1329 (1994) (as amended by Pub. L. No. 100-4, § 316(a), 101 Stat. 52 (Feb. 4, 1987)).

175. *Id*. § 1329(a)(1), (b).

176. *Id*. § 1329(e), (f), (h), (i).

substantive requirements on states except that they are to identify "the best management practices and measures" to reduce nonpoint source pollution from state-defined categories.[177] Nothing in the Clean Water Act requires states to actually enforce their nonpoint source programs, and the stringency of state programs varies considerably.[178]

In 1990, Congress amended the CZMA to require coastal states to address nonpoint source pollution in their coastal zone management programs.[179] Coastal states had to adopt measures that conformed to guidance from EPA and NOAA,[180] and states had to be able to enforce the measures that they enacted.[181] Thus, the CZMA's nonpoint source provisions are arguably more effective than the Clean Water Act's nonpoint source program. However, as previously discussed, the CZMA program is limited to the very narrow coastal zone and does not reach more landward causes of nonpoint source pollution.

The disparity in addressing point and nonpoint source of ocean pollution is obvious when the effects of Clean Water Act regulation in the United States are examined. The U.S.'s progress in controlling ocean-based pollution and point source discharges on land has generally been good. For example, EPA recently recognized that water clarity is generally good throughout the nation's coastal waters,[182] and oil spills have been decreasing in volume for the past

177. *Id*. § 1329(b)(2)(A).

178. Several authors discussed the need for more stringent nonpoint source pollution control. *See generally* John P. Almeida, Note, *Nonpoint Source Pollution and Chesapeake Bay Pfiesteria Blooms: The Chickens Come Home to Roost*, 32 GA. L. REV. 1195 (1998); Gabriel Calvo, *Voluntary Public-Private Nonpoint Source Pollution Projects: A Welcome Response to the Regulatory Shortcomings Under the Clean Water Act*, 3 GREAT PLAINS NAT. RESOURCES J. 159 (1999); Robin Kundis Craig, *Local or National? The Increasing Federalization of Nonpoint Source Pollution Regulation*, 15 J. ENVTL. L. & LIT. 179 (2000); Heather Darden, *Wastewater in the Florida Keys: A Call for Stricter Regulation of Nonpoint Source Pollution*, 16 J. LAND USE & ENVTL. L. 199 (2001); Daniel R. Mandelker, *Controlling Nonpoint Source Water Pollution—Can It Be Done?*, 65 CHI-KENT L. REV. 479 (1989); David Zaring, Note, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515 (1996).

179. Coastal Zone Act Reauthorization Amendment of 1990, Pub. L. No. 101-508, § 6217, 104 Stat. 1388-314 (Nov. 5, 1990) (codified as 16 U.S.C. § 1455(b)).

180. 16 U.S.C. § 1455b(b) (1994).

181. *Id*. § 1455(d)(16).

182. OFFICE OF WATER, EPA, *supra* note 135, at x.

twenty years, although the number of spills remains constant at 5000 to 7000 per year.[183] However, persistent and bioaccumulative toxics remain a problem. "[A]lmost 20,000 industrial and municipal discharges occur[] in estuarine waters of the United States" under the NPDES program,[184] and "[a]pproximately 160,000 factories dump 68,000 tons of toxic metals and 57,000 tons of toxic organic chemicals into the coastal waters of the United States each year."[185] A sediment toxicity study that began in 1991 indicates that 66% of sediments in estuaries are contaminated with toxic pollutants, a figure that rises to 80% for smaller estuaries,[186] and in January 2001, the EPA rated sediment contamination "poor" for all coastal areas except the Southeast.[187] Fish tissue contamination is slightly better, rated "fair" overall.[188]

Most current coastal pollution, however, comes from "sewer overflow, storm water runoff, polluted water runoff, and sewage treatment malfunctions"[189]—that is, from sewage system inadequacies and, more importantly, land-based nonpoint source pollution.[190] Some progress has been made.[191] For example, EPA has been implementing new stormwater regulations under the Clean Water Act throughout the 1990s, essentially bringing urban stormwater runoff within the NPDES permitting program, starting with the largest cities and activities first; by late 1999, these regulations reached cities of less than 100,000 people and construction sites of five acres or less.[192] EPA and NOAA revised

183. Debra Scholz et al., *Managing Oil Spills and Chemical Materials: Introduction*, *in* NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/hms_15/intro.html (last visited July 30, 2001).

184. OFFICE OF WATER, EPA, CLEAN WATER ACT SECTION 403 REPORT TO CONGRESS: PHASE II—POINT SOURCE DISCHARGES INSIDE THE BASELINE, *at* http://www.epa.gov/owow/oceans/cwa403ph2/cwa403_3.html (last revised July 5, 1995).

185. SVARNEY & BARNES-SVARNEY, *supra* note 129, at 431.

186. M.J. Hameedi et al., *Sediment Toxicity: National Picture*, *in* NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/sed_15/national.html (visited July 30, 2001).

187. OFFICE OF WATER, EPA, *supra* note 135, at x.

188. *Id.*

189. *Id*.

190. *Id.*

191. *Id.*

192. 64 Fed. Reg. 68,852, 68,852 (Dec. 8, 1999); 64 Fed. Reg. 68,722, 68,722 (Dec. 8, 1999).

their CZMA Guidance to require states to submit a fifteen-year nonpoint source strategy with five-year benchmarks and goals.[193] In addition, as of August 2001, all states received conditional approval of their CZMA nonpoint source management programs, and several states are well on their way to full approval.[194]

Nevertheless, in February 1998, the EPA and the U.S. Department of Agriculture (USDA) released their Clean Water Action Plan, concluding that "[p]olluted [r]unoff is the [m]ost [i]mportant [s]ource of [w]ater [p]ollution."[195] Further, they concluded that "[t]he success in cleaning up pollution from point sources (*e.g.*, factories and sewage treatment plants) has not yet been matched by controls over polluted runoff from sources such as farms, urban areas, forestry, ranching, and mining operations."[196] Because of nutrient runoff, "[t]he numbers and diversity of reported HAB incidents have increased during the past 25 years . . . to include almost every U.S. coastal state,"[197] costing the nation approximately $100 million per year.[198] Oceans off the United States also harbor increasing numbers of eutrophic and/or hypoxic (oxygen-lacking) areas.[199]

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193. NOAA & EPA, *Final Administrative Changes to the Coastal Nonpoint Pollution Control Program Guidance for Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA)*, *at* http://www.ocrm.nos.noaa.gov/czm/6217/admin_ changes.html (last revised July 29, 2001).

194. OFFICE OF OCEAN AND COASTAL RES. MGMT., NOAA, COASTAL NONPOINT POLLUTION CONTROL PROGRAM, *at* http://www.ocrm.nos.noaa.gov/czm/6217/ (last revised July 29, 2001).

195. Carol Browner & Dan Glickman, *Clean Water Action Plan: Clean Water Successes and Challenges*, *at* http://www.cleanwater.gov/action/c1a.html (last modified Feb. 19, 1998).

196. Carol Browner & Dan Glickman, *Clean Water Action Plan: Introduction*, *at* http://www.cleanwater.gov/action/intro.html (last modified Feb. 19, 1998).

197. K.L. Bushaw-Newton & K.G. Sellner, *Harmful Algal Blooms: National Picture*, *in* NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/hab_14/national.html (last visited July 30, 2001).

198. *Id*.

199. At least three hypoxic zones were discovered on the west coast, four more were identified on the east coast, and hypoxic zones are expected to double in the next decade. Josie Glausiusz, *Dead Zones*, 21 DISCOVER 22, 22 (Mar. 2000); *see also* Nancy N. Rabelais, *Oxygen Depletion in Coastal Waters: National Picture*, *in* NOAA, STATE OF THE COAST REPORT (1998), *at* http://state-of-coast.noaa.gov/bulletins/html/hyp_09/national.html (last visited July 30, 2001) (reporting oxygen depletion in 52% of major estuaries, although information is too sparse to accurately gauge trends). Moderate to high eutrophic conditions were recently reported for 65% of the nation's estuaries, Chris Clement et al., *Eutrophic Conditions in Estuarine Waters*, *in* NOAA, STATE OF THE COAST REPORT (2001), *at* http://state-of-coast.noaa.gov/bulletins/html/eut_18/eut.html (last visited July 30, 2001), and eutrophic status

Part of the continuing problem regarding marine pollution regulation is that the United States currently lacks a baseline standard of what overall ocean water quality should be. For internal fresh waters, the Clean Water Act creates this baseline through state-issued water quality standards.[200] However, states have no authority to set water quality standards for ocean waters more than three miles out to sea.[201] The EPA prepared new ocean discharge criteria that would establish "baseline water quality standards for ocean waters beyond three miles offshore.[202] These waters, designated 'Healthy Ocean Waters,' would be protected by both a narrative statement of desired quality and pollutant-specific numeric criteria," which would apply to all NPDES permits for discharges into the territorial sea, contiguous zone, or EEZ.[203] These new rules would have been the first national statement on ocean water quality since 1980, when the EPA published its last ocean discharge criteria,[204] and the first indication, in practical terms, of what the U.S.'s goals should be regarding ocean water quality. However, publication of the proposed rules was stalled when President Bush took office in January 2001,[205] and, as of March 2002, the EPA had not re-proposed them.

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is expected to worsen for 60% of monitored estuaries. NOAA, EXECUTIVE SUMMARY: TRENDS IN U.S. COASTAL REGIONS, 1970-1998, *at* http://state-of-coast.noaa.gov/natdialog/coastal_trends/exesummary.html (last modified Nov. 14, 2000).

200. *See* 33 U.S.C. § 1312(a) (1994) (requiring EPA to set water-quality-based effluent limitations when its standards effluent limitations are insufficient to achieve and maintain the desired water quality in a given water body); *see also id*. § 1313(d)(1)(A), (C) (requiring states to set total maximum daily loads, or TMDLs, for any waters where effluent limitations "are not stringent enough to implement any water quality standard applicable to such waters").

201. EPA, OCEAN DISCHARGE CRITERIA: REVISIONS TO THE OCEAN DISCHARGE CRITERIA REGULATIONS 10 (2001), *available at* http://www.epa.gov/owow/oceans/protecting_oceans/cwa403rule.pdf (last visited Mar. 22, 2002).

202. *Id*.

203. *Id.* at 10, 11. For a more detailed discussion of the proposed rules, including their potential legal problems, see Robin Kundis Craig & Sarah Miller, *Ocean Discharge Criteria and Marine Protected Areas*, 28:2 BOSTON C. ENVTL. AFFAIRS L. REV. 1, 29-44 (2001).

204. 45 Fed. Reg. 65,953 (Oct. 3, 1980), *codified at* 40 C.F.R. §§ 125.120 to 125.124 (2000).

205. *See* EPA, *supra* note 201, at 1 (citing President Bush's "Regulatory Review Plan," 66 Fed. Reg. 7701 (Jan. 24, 2001)); Office of Water, EPA, *Protecting Our Beaches, Oceans, and Coasts: Ocean Discharge Criteria*, *at* http://www.epa.gov/owow/oceans/protecting_oceans/ (last revised Feb. 23 2001).

IV. CONCLUSION

Between the continuing problems of nonpoint source pollution and toxic contamination and the lack of baseline standards for ocean water quality, current water quality regulation in the United States leaves considerable doubt as to whether mariculture can be a sustainable industry in the United States. Concentrations of toxics in marine sediments can poison bottom-dwelling mollusks such as oysters and clams, while nutrient contamination from upsteam runoff can cause HABs that both kill mollusks and render them unfit for human consumption. In addition, HABs contribute to ocean "dead zones," rendering areas of ocean unable to support any marine life—and killing any fish or shrimp that happen to be "penned" within the zone.

The U.S.'s marine water quality regulation thus still leaves mariculture operations vulnerable to nonpoint source pollution in the form of runoff and to point source pollution from sewage and discharges of pollutants and toxics. If sustainable mariculture is indeed a goal of the United States, as the several regulatory programs discussed above indicate it is, then ocean water must achieve guarantees of higher water quality, especially in the vulnerable coastal zone.

Currently, however, given the primacy of states in regulating both the first three miles of coastal waters and nonpoint source pollution, protection of mariculture facilities from upstream water quality problems is largely a matter of state discretion. Some states use this discretion to in fact promote mariculture.[206] For example, North Carolina classifies coastal waters where shellfish are grown as "SA" waters and has adopted water quality standards particular to those waters.[207] Specifically:

> The water quality standards for SA waters are promulgated specifically to protect the health and productivity of the shellfish and the health of the shellfish consuming public.

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206. *See generally*, *e.g.*, Daniel A. Curran, *The Legal Framework for Aquaculture in Rhode Island*, 44 R.I.B.R. 13 (1996).

207. *See* N.C. ADMIN. CODE, tit. 15A, r.2B.0200, & tit. 15A, r.2B.0108 (Oct. 2001).

> Waters not used for the production of shellfish are subject to a fecal coliform bacteria standard not to exceed a mean of 200 colonies/100 ml, while fecal coliform levels in SA waters must be kept below a median of 14 colonies/100 ml.[208]

The state also prohibits "the discharge of wastes into SA waters and unnamed tributaries of SA waters, 'which could adversely affect the taking of shellfish for market purposes,'"[209] and, "[t]o protect shellfish waters from bacteria-containing runoff, North Carolina has declared protection of shellfish waters from stormwater pollution to be the top priority for the state's stormwater control program and has adopted much more restrictive stormwater control requirements for land development activities on lands adjacent to SA waters than on lands adjacent to other waters."[210] Establishment of water quality standards to protect shellfish cultivation also gives North Carolina a direct handle on nonpoint source pollution that contaminates mariculture facilities through the Clean Water Act's total maximum daily load (TMDL) requirements.[211]

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208. Complaint, at 3, North Carolina Shellfish Growers Ass'n v. Holly Ridge Assocs., L.L.C., No. 7:01-CV-36-F(1) (E.D.N.C. filed Feb. 20, 2001); *see also* N.C. ADMIN. CODE, tit. 15A, r.28.0211(3)(e); 28.0220(3)(e); 28.0221(3)(d) (Oct. 2000).

209. Complaint, at 4, North Carolina Shelfish Growers Ass'n v. Holly Ridge Assocs., L.L.C., No. 7:01-CV-36-F(1) (E.D.N.C. filed Feb. 20, 2001) (quoting N.C. ADMIN. CODE, tit. 15A, r.2H.0404(a) (Oct. 1999)).

210. *Id*. (citing N.C. GEN. STAT. § 143-214.7(b)(1) (2000); N.C.ADMIN. CODE, tit. 15A, r.2H.1001-1013 (Oct. 1999)). For discussions of how states have more generally used their authority to protect their coastal zones from nonpoint source pollution, see Clare F. Saperstein, *State Solutions to Nonpoint Source Pollution: Implementation and Enforcement of the 1990 Coastal Zone Amendments Reauthorization Act Section 6217*, 75 B.U. L. REV. 889 (1995); Pamela S. Clarke & Stacey M. Cronk, Comment, *The Pennsylvania Nutrient Management Act: Pennsylvania Helps to "Save the Bay" through Nonpoint Source Pollution Management*, 6 VILL. ENVTL. L.J. 319 (1995).

211. *See* 33 U.S.C. § 1313(d) (1994) (requiring states to establish TMDLs for any waterbody not meeting its water quality standards). Both the EPA and federal courts established that states can address the water quality problems in these waters by addressing nonpoint source pollution that contributes to the problem. 40 C.F.R. § 130.2(i) (2000); 66 Fed. Reg. 53,044, 53,044 (Oct. 18, 2001) (noting that the EPA's proposed that new water quality rules would ensure "that necessary point and nonpoint source controls are implemented to meet TMDLs"); Am. Iron & Steel Inst. v. EPA, 115 F.3d 979, 1002 (D.C. Cir. 1997) (noting that the EPA Guidance indicates that both point and nonpoint sources of pollution are included in TMDLs); Pronsolino v. Marcus, 91 F. Supp. 2d 1337, 1346-56 (N.D. Cal. 2000) (holding that the EPA could set a TMDL for a river unable to meet the applicable water quality standards only because of nonpoint source pollution); Friends of the Wild Swan v. U.S. EPA, 130 F. Supp. 2d 1184, 1194 (D. Mont. 1999) (upholding Montana's consideration of nonpoint source pollution

Nevertheless, if promoting sustainable mariculture is a *federal* goal, state regulation of water quality protection is unlikely to achieve that goal. This result is especially true for those areas of the coast, such as the Mississippi River delta in the Gulf of Mexico, where ocean water quality is not the result of land-based water pollution generated within a single state, but rather the result of pollution from far upstream, from landlocked states with no interest in or access to mariculture facilities. Thus, for mariculture to sustainably add to the seafood productivity of the United States, the federal government needs to not only address the water quality problems that mariculture facilities generate, but also the larger land-based nonpoint source pollution problems that threaten to make large-scale sustainable mariculture impossible.

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in the TMDL context); Natural Res. Def. Council, Inc. v. Fox, 30 F. Supp. 2d 369, 382 (S.D.N.Y. 1998) (relying on the EPA's TMDL regulation that TMDLs consist of total point source, nonpoint source, and background pollution); Sierra Club v. Browner, 843 F. Supp. 1304, 1311 (D. Minn. 1993) (granting plaintiffs standing to sue over TMDLs for a waterway polluted only by nonpoint source pollution).