NET PENS WITH ADAPTIVE MANAGEMENT: HOW TO MANAGE THE EXPANSION OF AQUACULTURE USING THE CLEAN WATER ACT

> As for the highly uncertain potential from massive sea farming and the like, one must hope, pray, beg, and implore that man will tread extremely softly and assess with great care the possible consequences of any further major disruption of the world's gravely jeopardized underwater biology and chemistry. There is nothing at stake except an indispensable link in the planet's life chain and the primordial source of all earthly life.[1]

INTRODUCTION

The great potential for sea farming recognized in the 1970s is now a reality. Currently, aquaculture, the farming of aquatic organisms, is the fastest growing sector in the animal-food industry and has increased from four percent of global seafood production in 1970 to thirty percent in 2002.[2] That same year, the United States Department of Agriculture (USDA) estimated 6,653 "aquaculture facilities" were operating in the United States with a total of $1.1 billion in sales.[3] Aquaculture was valued in 2002 by the United Nations at sixty billion.[4] There is some consensus that in the near future, if trends continue, the majority of fish consumed will be raised in aquaculture instead of caught from the wild.[5] With the enactment of the

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1. William G. Hollingsworth, Comment, *World Population: An Unwishful Assessment, a Hopeful Proposal*, 10 B.C. ENVTL. AFF. L. REV. 853, 858 n.15 (1983).

2. FISHERIES DEP'T., U.N. FOOD & AGRIC. ORG. [FAO], THE STATE OF WORLD FISHERIES AND AQUACULTURE: 2004, at 14 (2004) [hereinafter SOFIA 2004]. The National Aquaculture Act defines aquaculture as "the propagation and rearing of aquatic species in controlled or selected environments, including, but not limited to, ocean ranching." National Aquaculture Act of 1980 § 3(1), 16 U.S.C. § 2802(1) (2000). This Note focuses on a subset of aquaculture commonly referred to as fish farming within the open ocean.

3. Aquaculture Network Information Center, 2002 Census of Agriculture: Aquaculture Summary, http://digbig.com/4sayq. "The term 'aquaculture facility' means any land, structure, or other appurtenance that is used for aquaculture and is located in any State. Such term includes, but is not limited to, any laboratory, hatchery, rearing pond, raceway, pen, incubator, or other equipment used in aquaculture." 16 U.S.C. § 2802(2) (2000).

4. SOFIA 2004, *supra* note 2, at 14.

5. *See* Don Staniford, Closing the Net on Sea Cage Fish Farming, Keynote Paper presented at Charting the Best Course: The Future of Mariculture in Australia's Marine Environment, a Conference Organized by the Queensland Conservation Council and the Australian Marine Conservation Society (Aug. 27, 2003), *available at* http://digbig.com/4ryan (stating that by 2010 fish from aquaculture will comprise fifty-six percent of the world's fish meal and ninety-eight percent of the fish oil); *see also* Juliet Eilperin, *Fish Farming's Bounty Isn't Without Barbs: Aquaculture May Change Way U.S. Eats, but Effect on Seas Is a Concern*, WASH. POST, Jan. 24, 2005, at A1 (noting that by 2025, it is predicted that half the fish consumed worldwide will be farm-raised).

National Offshore Aquaculture Act of 2005, and other incentives for aquaculture discussed in this Note, there is every indication that the trend will continue.[6] The Offshore Aquaculture Act encourages the development of the Exclusive Economic Zone (EEZ), an area of water that extends from three to two hundred nautical miles from land, by allowing open-ocean aquaculture.[7] The further development of open-ocean aquaculture would result in an increased number of "net pen systems," which are capable of placement in open water.[8] A coherent management plan is needed to contain the environmental effects from these net pens.

There was promise for such a plan when on August 23, 2004, the Environmental Protection Agency (EPA) promulgated a new rule designed to control the pollution produced from aquaculture facilities.[9] In essence, the rule establishes technology-based, narrative guidelines for all aquaculture facilities, also known as concentrated aquatic animal production facilities (CAAPFs).[10] The new rule appears to be making all the same mistakes as terrestrial farms with a lack of government oversight and insufficient technology to control pollution.[11]

This Note argues that the CAAPF rules are flawed and suggests some methods to fix them. Aquaculture management must reflect our knowledge of the farming industry while incorporating safety devices to guard against unknown scenarios. This management technique is a form of adaptive

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6. The National Offshore Aquaculture Act of 2005, S. 1195, 109th Cong. (2005). For a discussion of some of the incentives for the aquaculture industry, see *infra* Part I.

7. S. 1195 § 2; *see also* Proclamation No. 5030, 3 C.F.R. 22 (Mar. 10, 1983) (establishing the EEZ).

8. The Environmental Protection Agency (EPA) stated that:

> *Net pen system* means a stationary, suspended or floating system of nets, screens, or cages in open waters of the United States. Net pen systems typically are located along a shore or pier or may be anchored and floating offshore. Net pens and submerged cages rely on tides and currents to provide a continual supply of high-quality water to the animals in production.

Concentrated Aquatic Animal Production Point Source Category, 40 C.F.R. § 451.2(j) (2005). Net pen systems refer to an amalgam of individual net pens connected together, which individually may hold up to 40,000 fish each, with the entire system holding from 200,000 to 700,000 market-sized fish. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,900–01 (Sept. 12, 2002).

9. 40 C.F.R. §§ 451.20–.24 (2005).

10. *Id.* §§ 451.21–.23.

11. *See* Scott Jerger, *EPA's New CAFO Land Application Requirements: An Exercise in Unsupervised Self-Monitoring*, 23 STAN. ENVTL. L.J. 91, 127–28 (2004) (commenting that the EPA's reliance on unsupervised management practices and lack of oversight for large farms is unlikely to "significantly alter the *status quo*," but arguing that technology-based approaches might mitigate against the dangers of unsupervised management practices). Jerger argues that the EPA's failure to require reporting or to monitor management practices provides no incentive for the owners of these operations to pursue less environmentally harmful alternatives. *Id.* at 127.

management, a process that emphasizes monitoring and adjusting management practices to address new problems. This technique must be applied now before it is too late to change established practices.[12] This Note explains how definable measures of environmental impacts could be incorporated into the permitting scheme for net pens under the Clean Water Act (CWA) to enable a form of adaptive management.[13] Part I provides a background for aquaculture and its origins, environmental impacts, and expansion. Part II offers a brief overview of the CWA and describes how federal and state laws currently regulate net-pen aquaculture. Part III outlines the shortcomings of existing policies in aquaculture management on the national and state levels. Part IV introduces the concept of adaptive management and explains how, combined with the correct regulatory structure, adaptive management would provide some solutions to a currently inadequate regulatory framework for net pen systems.

I. BACKGROUND

An overview of the history of aquaculture regulation reveals certain trends that remain today. Twenty-six years ago, the U.S. government recognized the potential of aquaculture with the enactment of the National Aquaculture Act of 1980 (NAA).[14] The NAA sought to encourage aquaculture by affirming the importance of aquaculture development and providing economic incentives.[15] The Act was necessary because "[t]he harvest of certain species of fish and shellfish exceed[ed] levels of optimum sustainable yield," consumption of seafood was rising at a rapid rate,[16] and the United States was operating at a seafood-trade deficit.[17] The NAA requires that the USDA and other relevant bodies "prescribe such regulations as may be necessary to carry out [a National Aquaculture

12. There are net pens already operating over three miles off the U.S. coast in Alabama, Mississippi, Florida, Hawaii, New Hampshire, Texas, and Puerto Rico. *See* Press Release, Institute for Agriculture and Trade Policy, New Report Documents Efforts to Privatize Ocean for Fish Farming (Feb. 10, 2004), *available at* http://digbig.com/4ryap.

13. Clean Water Act, 33 U.S.C. §§ 1251–1387 (2000). The Federal Water Pollution Control Act Amendments of 1972 broadly set objectives for "restor[ing] and maintain[ing] the chemical, physical, and biological integrity of the Nation's waters." Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500, § 101(a), 86 Stat. 816, 816 (1973) (codified at 33 U.S.C. § 1251(a) (2000)). With the 1977 Amendments, the Act became commonly known as the Clean Water Act. Clean Water Act of 1977, Pub. L. No. 95-217, § 518, 91 Stat. 1566, 1566 (1980) (codified at 33 U.S.C § 1251 (2000)).

14. National Aquaculture Act of 1980, Pub. L. No. 96-362, 94 Stat. 1198 (codified at 16 U.S.C. §§ 2801–10 (2000)).

15. 16 U.S.C. § 2801(b)(1).

16. *Id.* § 2801(a)(1).

17. *Id.* § 2801(a)(2).

Development] Plan."[18] The USDA and the Joint Subcommittee on Aquaculture (JSA) were tasked with carrying out this plan but have primarily focused on how to encourage rather than regulate aquaculture.[19] Even the EPA historically saw its role as one of promoting commercial aquaculture.[20] In fact, the CWA has a specific exception within it for the regulation of aquaculture. Termed "approved aquaculture projects," this regulation authorized the EPA to permit pollution from aquaculture that would otherwise be illegal.[21]

The United States's seafood demands continue to increase,[22] and the United States continues to import the majority of its seafood, causing it to operate at a six-billion-dollar-per-year-seafood-trade deficit.[23] Meanwhile, global "wild" fisheries are declining at an unprecedented level.[24] In fact, the FAO estimates that fifty-two percent of global marine fisheries are currently "fully exploited."[25] In response to these numbers, the National Oceanic and Atmospheric Association (NOAA) states that the promotion of

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18. *Id.* § 2804(a)(4). The National Aquaculture Development Plan is defined at § 2803.

19. *See* D. Douglas Hopkins et al., *An Environmental Critique of Government Regulations and Policies for Open Ocean Aquaculture*, 2 OCEAN & COASTAL L.J. 235, 249–50 (1997) (observing that the JSA has not focused on regulatory constraints but instead has focused on "market development needs, technology development, and federal research funding."). Section 2805(a) of the NAA establishes the JSA and § 2805(b) defines its purpose. 16 U.S.C. § 2805(a)–(b).

20. *See* 40 C.F.R. § 125.10(b) (2000) (stating that the EPA's "policy is to encourage such [aquaculture] projects, while at the same time protecting other beneficial uses of the waters.").

21. *Id.*; *see also* 33 U.S.C. § 1328 ("The administrator is authorized, after public hearings, to permit the discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project . . . ."). To obtain a permit, the EPA requires, among other things, that aquaculture projects produce something of potential commercial value, produce only nonindigenous species, and comply with the ocean-discharge criteria of the CWA. 40 C.F.R. § 125.11 (2005); *see also* Robin Kundis Craig, *The Other Side of Sustainable Aquaculture: Mariculture and Nonpoint Source Pollution*, 9 WASH. U. J.L. & POL'Y 163, 181 (2002) (stating that the overall purpose of the approved aquaculture project regulations is "to ensure that aquaculture facilities are sufficiently confined and productive to justify intentional pollution of the navigable waters").

22. NAT'L OCEANIC AND ATMOSPHERIC ADMIN. (NOAA), U.S. DEP'T OF COMMERCE, NOAA FISHERIES STRATEGIC PLAN 16–17 (1997), *available at* http://digbig.com/4ryaq [hereinafter NOAA, FISH STRATEGIES PLAN]. The average person in the United States consumes over sixteen pounds of seafood per year. Press Release, NOAA, Seafood Consumption Rose Again in 2003 (Sept. 27, 2004), *available at* http://digbig.com/4ryar. People in the United States consumed roughly 4.7 billion pounds of seafood in 2003, with the average person consuming a record 16.3 pounds of fish and shellfish, up from 15.6 pounds in 2002. *Id.*

23. Dep't of Commerce, Aquaculture Policy, *available at* http://digbig.com/4ryas [hereinafter DOC, Aquaculture Policy].

24. *See* Janet Larsen, *Wild Fish Catch Hits Limits—Oceanic Decline Offset by Increased Fish Farming*, http://www.earth-policy.org/Indicators/Fish/2005.htm (observing that despite an increase in the number of fishing vessels and improved technology, the amount of wild fish caught every year is decreasing because of near depletion).

25. SOFIA 2004, *supra* note 2, at 32.

aquaculture is a national objective,[26] and the Department of Commerce (DOC) is set to quintuple the national yield of seafood produced from aquaculture by the year 2025.[27] The NOAA allocates approximately twelve to fourteen million for aquaculture development and the USDA's budget for aquaculture is approximately fifty million.[28] Economic incentives are also present in the form of traditional farm subsidies,[29] and matching funds are available to build aquaculture facilities for commercial production.[30]

To regulate the environmental impact from aquaculture, the EPA has promulgated technology-based, narrative, effluent-limitation guidelines (ELGs) and new source performance standards for CAAPFs.[31] The guidelines apply only if the aquaculture facility is first designated as a CAAPF, which is done according to the total weight of feed applied or total weight of animals produced.[32] The ELGs apparently recognize that aquaculture facilities need to abide by certain management practices, but, as discussed in Part III, the actual regulations are so vague that they do not provide a template that will ensure acceptable management of net pens.

The proposed National Offshore Aquaculture Act of 2005 represents the latest effort to encourage the development of aquaculture, and particularly net pens, under the auspices of proper management. The NOAA declares that this Act will require the DOC to issue permits for aquaculture "while providing environmental and other safeguards to protect wild stocks, marine ecosystems, and other users."[33] To date, however, no safeguards have been proposed other than the flawed ELGs and it is not clear that even these guidelines will apply to facilities located in the EEZ.[34]

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26. NOAA, FISH STRATEGIES PLAN, *supra* note 22, at 16.

27. By 2025 the DOC has an aquaculture policy objective to "[i]ncrease the value of domestic aquaculture production from the present $900 million annually to $5 billion." DOC, Aquaculture Policy, *supra* note 23.

28. REBECCA GOLDBURG ET AL., MARINE AQUACULTURE IN THE UNITED STATES: ENVIRONMENTAL IMPACTS AND POLICY OPTIONS 22 (2001), *available at* http://digbig.com/4ryat.

29. *See, e.g.*, 7 C.F.R. § 762.102(b) (2005) (including permitted aquaculture operations in the definition of farm).

30. The National Agricultural Research, Extension, and Teaching Policy Act provides qualifying aquaculture facilities with $7.5 million each fiscal year through 2007. National Agricultural Research, Extension, and Teaching Policy Act of 1977 § 1477, 7 U.S.C. § 3324 (Supp. II 2002).

31. 40 C.F.R. §§ 451.20–.24 (2005).

32. Non-net-pen facilities containing cold-water fish species will only be regulated as a CAAPF if they discharge at least thirty days per year and produce more than about twenty thousand pounds of aquatic animals per year or feed more than five thousand pounds of food during the calendar month of maximum feeding. 40 C.F.R. § 122 app. C § (a) (2005). Facilities containing warm-water species are regulated only if they produce more than approximately one hundred thousand pounds of aquatic animals per year. *Id.* app. C, § (b).

33. NOAA, NOAA Releases Offshore Aquaculture Bill, http://digbig.com/4ryaw (last visited Jan. 31, 2006).

34. CWA regulation of open-ocean aquaculture is uncertain because aquaculture located in the

Instead, in the proposed Act, the DOC is responsible only for considering risks of environmental impact that the Secretary of Commerce identifies.[35] To date, the DOC has not identified any specific risks that it intends to incorporate into the permits for aquaculture in the EEZ. Understanding both the actual and potential impact of net-pen aquaculture on the environment is necessary in order to implement any kind of scheme to regulate the industry.

A. The Environmental Impact of Net-Pen Aquaculture

Net pens alter the environment by adding waste, feed, chemicals, parasites, and alien species into the water.[36] "[Aquaculture] may also pose a variety of ecological risks . . . . These risks include increased competition and predation, displacement of natural fish, altered migratory and spawning behavior, and disease transfer."[37] These environmental impacts must be contained if there is hope for a successful aquaculture-management plan.

EEZ may be outside the CWA's jurisdiction. The Center for Food Safety requested that the EPA explicitly acknowledge that effluent standards under the CWA apply to aquaculture in the EEZ. Letter from Tracie Letterman, Fish Program Director, Center for Food Safety, to EPA (Feb. 10, 2004) (on file with *Vermont Law Review*). However, the EPA chose to maintain almost the original language of the Act, regulating CAAPFs "that discharge directly to U.S. waters." Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed Reg. 51,892, 51,892 (Aug. 23, 2004). The CWA only prohibits discharges of pollutants into "navigable waters," 33 U.S.C. §§ 1311(a), 1362(12) (2000), and navigable waters are defined as "the waters of the United States including the territorial seas." *Id.* § 1362(7). Neither the statute nor the ensuing regulations expressly mention the regulation of the EEZ, which is beyond the three-mile boundary of the territorial seas. *Id.*; Definition of Waters of the United States, 33 C.F.R. § 328.3 (2005). The National Offshore Aquaculture Act of 2005 would make the DOC the lead agency that, "in consultation as appropriate with other relevant Federal agencies," can develop procedures and issue permits to eligible persons. The National Offshore Aquaculture Act of 2005, S. 1195, 109th Cong. § 4(a)(1) (2005). The CWA is not explicitly mentioned anywhere in the proposed Act except, perhaps, by implication—"[p]ermits issued under [the] Act do not supersede or substitute for any other authorization required under applicable Federal or State law or regulation." *Id.* § 4(a)(7).

35. The National Offshore Aquaculture Act of 2005, S. 1195, 109th Cong. § 4(d)(2) (2005). This provision also mentions that the Secretary should consult with the other "appropriate" federal agencies before determining the environmental risks of issuing a permit but does not mention any specific agencies. *Id.*

36. *See* Staniford, *supra* note 5 (stating that no matter the farmed species location, "'five fundamental flaws' remain the same; namely: untreated wastes; mass escapes; diseases and parasites; toxic chemicals and fish feed/food").

37. Interim Policy on Artificial Propagation of Pacific Salmon Under the Endangered Species Act, 58 Fed. Reg. 17,573, 17,574 (Apr. 5, 1993).

1. The Accumulation of Pollution Below and Around Net Pens

The amount of pollution stemming from net-pen operations is truly staggering. Net-pen populations are fed by "blower mechanism[s]," three or four times a day, and, if they house salmon, the feed typically contains poultry parts, ground-up fish, and a pigment intended to color the fish's flesh pink.[38] Fifteen to twenty percent of this food falls to the seafloor.[39] Therefore, a salmon aquaculture facility, meeting the *minimum* CAAPF designation would incidentally cause 750 to 1000 pounds of food waste to accumulate beneath the net pen per month.[40] The amount of fish feces produced by net pens is also substantial. According to one study, "a fish farm of 200,000 salmon would produce an amount of nitrogen, phosphorus, and biological oxygen demand (or fecal matter) equal to that produced by 15,000, 26,667, and 62,505 people, respectively, per day."[41] The fish feces produced from aquaculture in Maine alone is roughly equivalent to twice the amount of raw sewage that all Maine residents produce.[42] This waste is not contained in any way and flows directly into the ocean through the pens. The decomposition of fish food and waste is known to change the chemical and biological composition of sediment naturally found on the sea floor and cause a decrease in animal diversity around the net pen.[43]

There is some debate as to the extent of the environmental impacts caused by the accumulation of pollution below net pen systems. Direct environmental impacts on the sea floor have been observed at distances from one hundred to five hundred feet from the site.[44] Some believe that net pens can create "death zones," an area devoid of life except algae and bacteria.[45] The pollution produced by net pens has not been confined to the

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38. *See, e.g.*, U.S. Pub. Interest Research Group v. Atl. Salmon of Me. (*Atlantic Salmon II*), 257 F. Supp. 2d 407, 411, 413 (D. Me. 2003) (describing the aquaculture operations of Atlantic Salmon of Maine and Stolt Sea Farm who were both defendants in this suit), *aff'd*, 339 F.3d 23 (1st Cir. 2003).

39. MICHAEL L. WEBER, SEAWEB AQUACULTURE CLEARINGHOUSE, WHAT PRICE FARMED FISH: A REVIEW OF THE ENVIRONMENTAL & SOCIAL COST OF FARMING CARNIVOROUS FISH 20 (2003) [hereinafter WEBER, WHAT PRICE FARMED FISH], *available at* http://digbig.com/4says.

40. Under the applicable regulation, 40 C.F.R. § 122 app. C § (a)(2) (2005), net pens holding salmon, a cold-water fish, would be regulated if they used at least five thousand pounds of feed per month.

41. Brian R. Price II, Note, *Maine Aquaculture, Atlantic Salmon, and Inertia: What Is the Future for Maine's Net Pen Salmon Industry?* 31 B.C. ENVTL. AFF. L. REV. 683, 714 (2004) (citing Ronald W. Hardy, *Fish Feeds and Nutrition—Urban Legends and Fish Nutrition*, AQUACULTURE MAG., Nov.–Dec. 2000, at 47, 47–50, *available at* http://digbig.com/4ryay).

42. *Id.* at 714–15.

43. GOLDBURG ET AL., *supra* note 28, at 13.

44. *Id.* (citation omitted).

45. *Id.*; Telephone Interview with Ronald Lavigne, Assistant District Attorney, Washington State Department of Ecology (Mar. 18, 2005). One court noted that "the footprint [of net pens] consists

area directly below net pens. The pollution from CAAPFs is known to alter the environment. In fact, seven states identify CAAPFs as a source of impairment to one or more of its water bodies.[46] Net pens, being located in the open ocean, have the potential to spread pollution over long distances.

Strong evidence from a number of countries suggests that untreated waste from net pens can cause toxic algal blooms on a massive scale.[47] Algal blooms produce a marine biotoxin that accumulates in shellfish, which can result in Paralytic Shellfish Poisoning in humans who consume those shellfish.[48] Algal blooms can also cause fish kills. For example, in South Australia, it is believed that a toxic algal bloom killed seventy-five percent of farmed tuna stock; although officially labeled as a "natural event," many blame waste from the aquaculture industry.[49] A water sample taken from the area after the incident revealed the presence of a toxic alga not naturally found in the area.[50] This alga was found in Japan where it was linked with fertilization of water by aquaculture wastes.[51] Indeed, some scientists have plainly stated that organic wastes from aquaculture contribute to toxic algal bloom incidents.[52] A possible rationale for covering up the true culprit of some algal blooms is that aquaculture can be reimbursed for lost revenue if algae blooms are labeled "acts of God."[53] Between 1999 and 2002 salmon farms in Scotland experienced the die-off of four million salmon in their net pens and half of these were compensated

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of large patches and contiguous mats of beggiatoa [nuisance bacteria], anoxia, and black sediments, and the release of methane and hydrogen sulfide gases." *Atl. Salmon II*, 257 F. Supp. 2d 407, 419 (D. Me. 2003). *But see* Marine Envtl. Consortium v. Washington, No. 96-257, 1998 WL 934931, at *16 (Wash. Pollution Control Hearings Bd. Nov. 30, 1998) (finding that the existence of "death zones" has not been proven).

46. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,910 (Sept. 12, 2002). These states are Illinois, Louisiana, North Carolina, New Hampshire, New Mexico, Ohio, and Virginia. *Id.* This impairment is on rivers and streams rather than the ocean and therefore likely is due to other forms of aquaculture. *See id.* at 57,910–11 (noting that these impaired waters are lakes, rivers, and streams). However, it should not be forgotten that the same kind of effluents are being released into the open ocean and are likely to disrupt the environment around them.

47. Staniford, *supra* note 5.

48. Magnuson-Stevens Fishery Conservation and Management Act Provisions; Fisheries of the Northeastern United States; Emergency Fishery Closure Due to the Presence of the Toxin that Causes Paralytic Shellfish Poisoning (PSP), 70 Fed. Reg. 35,047, 35,047 (June 16, 2005) (to be codified at 50 C.F.R. pt. 648).

49. Staniford, *supra* note 5.

50. *Id.*

51. *Id.*

52. *Id.*

53. *See id.* (arguing that those who intentionally undertake aquaculture should not be allowed to collect insurance for the destruction of their aquaculture facilities under the guise of an "act of God").

by insurance claims of "naturally occurring algal blooms."[54]

New England recently experienced the largest toxic algal bloom in history causing the Food and Drug Administration to issue a public health emergency.[55] The National Marine Fisheries Service (NMFS) forced the closure of nearly all shellfish fisheries in federal waters off the Northeastern United States for a minimum of three months.[56] Fish farms have not been mentioned as a possible cause in New England, yet it is difficult to rule them out as contributors due to their proliferation and waste production.[57] This incident illustrates the potential impact from a severe toxic algal bloom in just one U.S. region—in the order billions of dollars from lost revenue and unemployment in the area.[58]

2. Alien Introductions, Genetic Pollution, and Disease

Fish regularly escape from their net pens.[59] Small-scale escapes are expected among net pens and occur during normal operations of transport and maintenance.[60] Small-scale escapes are a problem, but larger escapes also happen with surprising frequency. Larger escapes "occur when storms, marine mammals, vandalism, or human error damage" net-pen facilities.[61] Massive numbers of aquaculture escapes have occurred all over the world, including about 500,000 salmon or trout every year in Norway,[62] over 629,000 salmon escapees during one month in Scotland,[63] and over 30,000

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54. *Id.*

55. Magnuson-Stevens Fishery Conservation and Management Act Provisions; Fisheries of the Northeastern United States; Emergency Fishery Closure Due to the Presence of the Toxin that Causes Paralytic Shellfish Poisoning (PSP), 70 Fed. Reg. 35,047, 35,047 (June 16, 2005) (to be codified at 50 C.F.R. pt. 648).

56. *Id.*

57. A recent count revealed that there were forty-three aquaculture sites with over 750 cages in Maine alone. NAT'L MARINE FISHERIES SERV. & U.S. FISH AND WILDLIFE SERV., DRAFT RECOVERY PLAN FOR THE GULF OF MAINE DISTINCT POPULATION SEGMENT OF ATLANTIC SALMON (*SALMO SALAR*) 1-56 (2004), *available at* http://digbig.com/4ryba [hereinafter NMFS DRAFT].

58. Losses from the New England shellfish-aquaculture industry alone "are estimated at $3 million a week." Red Tide Emergency Relief Act of 2005, S. 1316, 109th Cong. § 2(3) (2005).

59. *See* Rosamond Naylor et al., *Fugitive Salmon: Assessing the Risks of Escaped Fish from Net-Pen Aquaculture*, 55 BIOSCIENCE 427, 427 (2005), *available* http://digbig.com/4rybb ("[E]scapes occur in all aquaculture regions both through regular, low-level 'leakage' and through episodic events such as storms.").

60. GOLDBURG ET AL., *supra* note 28, at 6.

61. *Id.*

62. Amanda Brown, *Wild Salmon Under Threat from Farmed Fish*, THE PRESS ASS'N LIMITED, May 12, 2005. "[O]ne out of every four salmon or trout found in Norway's coastal waters are fish farm escapees." *Id.*

63. *Id.*

kingfish escapees in Australia between 2001 and 2003.[64] In the United States, Maine and Washington—two states with robust aquaculture industries—have both experienced repeated, massive escapes from their salmon-fish farms. For example, in Washington, 107,000 salmon escaped due to an anchor-line failure in 1996, and, in 1997, a towing accident resulted in the release of 369,000 salmon.[65] That same year, a storm caused 100,000 hybrid salmon to escape from one farm in Maine.[66]

Regular escapes threaten genetic pollution, increase competition with native species, and transport disease.[67] To make matters worse, these threats can impact native species listed under the Endangered Species Act (ESA).[68] Some fish species are especially problematic for net pen systems.[69] However, because salmon have many attributes common to other farmed species, they provide a prime example of the dangers that could result in the mixing of farmed and wild fish.[70] On November 17, 2000, the federal government listed the wild Atlantic salmon, which is genetically distinct from farmed and Pacific salmon, as an endangered species.[71] In 2002, the government estimated the number of wild Atlantic salmon in the Gulf of Maine at a range from twenty-three to forty-six individuals, which returned to spawn in only eight tributaries.[72] This is a tiny fraction of the salmon's historic population in the Gulf of Maine.[73] In the western United States, twelve species of salmon, determined to be "Evolutionarily Significant Units," were listed as threatened and another four were listed as endangered on August 29, 2005.[74]

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64. Andrew McGarry, *Kingfish Slip Net . . . Again*, THE AUSTRALIAN, Nov. 27, 2003, at 5.

65. Marine Envtl. Consortium v. Washington, No. 96-257, 1998 WL 934931, at *5 (Wash. Pollution Control Hearings Bd. Nov. 30, 1998).

66. U.S. Pub. Interest Research Group v. Atl. Salmon of Me. (*Atl. Salmon I*), 215 F. Supp. 2d 239, 244 (D. Me. 2002).

67. *Atlantic Salmon II*, 257 F. Supp. 2d 409, 420 (D. Me. 2003).

68. The Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2000).

69. *See, e.g.*, Naylor et al., *supra* note 59, at 435 ("Cod are . . . known to produce fertilized eggs in ocean enclosures. . . . [N]either pens nor cages can contain fish eggs . . . . " (citing Rebecca Goldburg & Rosamond Naylor, *Future Seascapes, Fishing, and Fish Farming*, 3 FRONTIERS IN ECOLOGY & ENV'T 21, 24 (2005), *available at* http://digbig.com/4sayw).

70. *Id.* at 428.

71. Endangered Marine and Anadromous Species, 50 C.F.R. § 224.101 (2005).

72. NMFS DRAFT, *supra* note 57, at 1-4.

73. *See id.* at 1-4 to 1-5 (describing historically abundant populations in the Gulf of Maine and elsewhere along the Atlantic seaboard).

74. Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs, 70 Fed. Reg. 37,160, 37,160 (June 28, 2005).

The influx of fish from aquaculture could cause a dilution of the genetic vitality of wild fish if they successfully interbreed.[75] This is because farmed fish are of low genetic diversity and are mostly descendents from the Norwegian stocks used in the 1970s.[76]

Scientists note that regardless of whether farmed and wild fish interbreed, the frequency of escapes will ensure that farmed fish have a significant impact on wild fish because they compete for finite resources.[77] Indeed, "the release of large numbers of hatchery fish can elevate levels of competition for food, habitat, or mates and may lead to displacement of natural fish from their habitat."[78]

The NOAA and the Fish and Wildlife Service (FWS) consider aquaculture to be a severe threat to the survival of wild Atlantic salmon in Maine.[79] The NMFS admits that "comprehensive protective solutions to minimize the threat of interactions between wild and aquaculture salmon have not yet been fully implemented."[80] To address this problem, the Atlantic Salmon Draft Recovery Plan calls for aquaculture facilities to "develop contingency plans in case of an accidental release of farmed salmon."[81] The development of contingency plans represents a useful step in the management of escapes, but it is likely to be ineffective because it depends on farmers to report escapes without any assurance that all incidents are reported.[82] Even if facilities report escapes, it may be less costly to allow the escapes to continue rather than to improve containment systems.[83] Without a strong monitoring and reporting system, no

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75. There is some debate about the capability of wild and captive fish to interbreed. Naylor et al., *supra* note 59, at 429 (citation omitted) ("Escaped farm salmon are successfully breeding in the wild in Norway, Ireland, the United Kingdom, and eastern North America . . . . [F]eral Atlantic salmon populations have been found in rivers in British Columbia . . . and in South America . . . . Several feral populations of Pacific salmon have also become established in Chile and Argentina as a result of . . . escapes from aquaculture facilities . . . .").

76. *Id.* at 430.

77. *Id.* at 429–30.

78. Interim Policy on Artificial Propagation of Pacific Salmon Under the Endangered Species Act, 58 Fed. Reg. 17,573, 17,574 (Apr. 5, 1993).

79. NAT'L MARINE FISHERIES SERV. & U.S. FISH & WILDLIFE SERV., FINAL RECOVERY PLAN FOR THE GULF OF MAINE DISTINCT POPULATION SEGMENT OF ATLANTIC SALMON (*SALMO SALAR*) 1-79 (2005), *available at* http://www.nero.noaa.gov/nero/hotnews/salmon/FinalATSRPlan.pdf.

80. *Id.* at 1-80.

81. NMFS DRAFT, *supra* note 57, at 4-53.

82. *See* Naylor et al., *supra* note 59, at 433 ("Where reporting is required, the extent of compliance is unknown. . . . Fines for major escape[s] . . . are rarely sufficient to induce a change in practice.").

83. *See id.* at 432 ("Even with chronic leakage, aquaculture firms often weigh the benefits of eliminating escapes against the financial costs of improving the strength and durability of net pens, altering harvest equipment, and other measures. The nonmarket costs of escapes (i.e., effects on wild populations and ecosystems) do not pose direct financial burdens on producers.").

management plan will regulate any net pen system effectively.

There is also much concern about disease transfer to wild fishes.[84] Like all animals densely packed into small areas, fish in net pens succumb to a number of communicable diseases.[85] These diseases can spread outside of the net pen when fish escape.[86] However, it is likely that diseases can spread regardless of whether there is an escape. There is evidence linking the outbreak of pathogens and parasites in wild fish to increased contact with farmed fish.[87] A recent study found that "clouds of [sea] lice infected the . . . wild salmon at unnaturally high rates for nearly 19 miles around the [aquaculture] farm. . . . '[T]his means that the parasite footprint of the farm is 150 times larger than the farm itself.'"[88] Some of these diseases that occur in net pens are not currently treatable.[89] Unique diseases have the potential to be transported through aquaculture.[90] Fish diseases might spread in the close quarters of net pens and emerge as an epidemic in wild populations.[91] The presence of these diseases could be the final blow to endangered fish. Scientists fear that diseases transmitted to wild fish from farmed fish will ultimately result in the loss of "one wild fish to disease for every farmed fish," which will devastate the marine ecosystem.[92]

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84. *See, e.g.*, *Atl. Salmon II*, 257 F. Supp. 2d 409, 413 (D. Me. 2003) (noting that the plaintiff was concerned that the transmission of an incurable disease known as Infectious Salmon Anemia posed "a significant threat to the remaining endangered wild salmon").

85. Staniford, *supra* note 5 ("[D]iseases and parasites are simply a function of intensification and overproduction." (citing *Farmed Fish with Parasites: Impact on Wild Fish Stocks*, BIOLOGIST, Aug. 2003)).

86. Naylor et al., *supra* note 59, at 431 ("Various pathogens and parasites have been detected in escaped farm salmon. Infected escapees are suspected to have transmitted furunculosis disease to wild stocks . . . .").

87. *See id.* ("[E]pidemiological patterns in Ireland, Scotland, Norway, and Canada suggest that outbreaks of sea (or salmon) lice . . . in wild fish are connected with the increased concentration of aquaculture . . . .").

88. John Heilprin, *Study: Salmon from Farms Breed Sea Lice*, SFGATE.COM, March 30, 2005, http://digbig.com/4rybc (quoting Dr. John Volpe, a marine ecologist from the University of Victoria).

89. *See, e.g.*, Veterinarian Services., Animal and Plant Health Inspection Service, United States Department of Agriculture, Infection Salmon Anemia, (Jan. 2002), http://digbig.com/4rybd ("There is currently no cure for the ISA virus.").

90. Naylor et al., *supra* note 59, at 431 ("Infected escapees are suspected to have transmitted furunculosis[, a disease first discovered in aquaculture,] to wild stocks . . . .").

91. *See* Ben Belton, *High Seas Drifters*, THE ECOLOGIST, July/August 2004, at 34, 36 ("As the number of fish species raised in offshore cages expands, numerous virulent new diseases are likely to emerge.").

92. *See id.* at 37 (quoting Dr. Neil Frazer, University of Hawaii).

3. Medications and Chemicals

A cocktail of medications and chemicals are applied to net pens to combat the various diseases that plague farmed fish. According to one source, U.S. fish farmers apply between 200,000 and 433,000 pounds of antibiotics to aquaculture facilities annually.[93] Chemicals are introduced directly or via fish food: "antibiotics, parasiticides (parasite-killing drugs), pesticides, hormones, anesthetics, various pigments, minerals, and vitamins" are all added with regularity.[94] In order to discourage marine organisms from colonizing on the nets themselves, net pens are laced with a chemical "antifoulant," which typically contain chemicals such as copper that are toxic to aquatic organisms.[95] Net pens slowly decompose and release these chemicals into the water.[96]

Antibiotics and medicated food can also fall through the net pen and be swept out to sea by the current.[97] Some of these medications do not have approval from the Food and Drug Administration (FDA).[98] A persistent fish parasite commonly referred to as "sea lice" is treated by applying large amounts of a medication known, at least in Canada, as "Slice."[99] The chemical components of Slice are known to be human neurotoxins.[100] Drugs in a water environment can bioaccumulate in nontarget species.[101] It is therefore logical to infer that aquaculture presents a human health risk when these contaminated fish are consumed by humans.[102]

Clearly, aquaculture needs a comprehensive plan to prevent the myriad of environmental impacts associated with them. Negative press on the environmental and public health consequences of net pens has caused organizations to recommend against the consumption of fish that were raised in net pens.[103] Good management practices may serve as an

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93. HeartsandMinds.org, Farmland Use: A Vital Resource, http://digbig.com/4rybe (attributing these statistics to the Institute for Trade and Agriculture Policy) (last visited Apr. 19, 2006).

94. GOLDBURG ET AL., *supra* note 28, at 14.

95. *Atl. Salmon II*, 257 F. Supp. 2d 409, 412–13 (D. Me. 2003). Copper is listed by the EPA as a toxic pollutant. 40 C.F.R. § 401.15 (2005).

96. *See Atl. Salmon II*, 257 F. Supp. 2d at 413 (noting that the plaintiff asserted that the copper from net pens "is released into the marine environment").

97. *Id.*

98. *See id.* at 413–14 (noting that Stolt Sea Farm uses cypermethrin in a product named Excis, which the FDA has not approved).

99. Natalie M. Henry, *Salmon: Enviros Sound Alarm Over Neurotoxin in Farmed Fish*, GREENWIRE, Dec.10 2004, http://digbig.com/4rybf.

100. *Id.*

101. GOLDBURG ET AL., *supra* note 28, at 16.

102. *See id.* ("The use of antibiotics, however, is arguably a health risk for people and farmed fish, since it promotes the spread of antibiotic-resistance in both human and fish pathogens.").

103. *See, e.g.*, Monterey Bay Aquarium: Seafood Watch, Salmon: Quick Fact: Fish Farming,

incentive for the aquaculture industry to encourage and support the establishment of a regulatory framework that could boost consumer confidence in their industry. Consumer choices alone cannot substitute for good regulation. Aquaculture facilities must be required to implement a management plan that is adaptable and monitored on a regular basis under the CWA. Such a management plan is consistant with the history and the goals of the CWA.

II. A PRIMER ON THE CLEAN WATER ACT

The goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[104] The principle means of accomplishing this goal is that, unless otherwise permitted, "the discharge of any pollutant [into navigable waters] by any person shall be unlawful."[105] A permit to discharge is available through the National Pollutant Discharge Elimination System (NPDES) program.[106] The NPDES permit program regulates the discharge of "any pollutant" from any "point source" into navigable waters.[107] This program allows the EPA to issue permits for discharges that otherwise would be illegal.[108] The permits require that dischargers use technology-based[109] and water-quality-based effluent limitations for point sources.[110]

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http://digbig.com/4rybg (last visited Apr. 19, 2006) (informing consumers about the threats associated with salmon from aquaculture and advising consumers to purchase wild salmon, preferably from Alaska); Seafood Choices Alliance, About Us, http://www.seafoodchoices.org/aboutus.php (last visited Apr. 19, 2006) (stating that the mission of the organization is to "bring[] together the leaders from the seafood and restaurant industries, conservation organizations and education institutions, enabling them to advance actions that reflect their shared concern for the long term supply of seafood and the long term health of the ocean environment"). On the other hand, fish like tilapia and catfish are recommended as sustainable. *Id.*

104. 33 U.S.C. § 1251(a) (2000).

105. *Id.* §§ 1311(a), 1362(12).

106. *Id.* § 1342(a).

107. *Id.* § 1342. "The term 'discharge of a pollutant' . . . means . . . any addition of any pollutant to navigable waters from any point source . . . ." *Id.* § 1362(12). "The term 'point source' means 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." *Id.* § 1362(14).

108. *Id.* § 1342 ("[T]he Administrator may . . . issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 1311(a) of this title . . . .").

109. *See id.* § 1311(b) (requiring effluent limitations for points sources and use of "the best practicable control technology currently available as defined by the Administrator pursuant to section 1314(b)" of the CWA).

110. *Id.* § 1312 (applying state water-quality standards unless it is not consistent with the CWA). When a state takes on implementation of a water-quality plan, the state water-quality standards must "protect the public health or welfare" and "enhance the quality of water." *Id.* § 1313(c)(2)(A).

Technology-based requirements promulgated on a case-by-case basis are known as effluent limitation guidelines (ELGs).[111] The ELGs "are established by regulation for categories of industrial dischargers and are based on the degree of control that can be achieved using various levels of pollution control technology."[112] ELGs consist of the application of best-conventional-control technology (BCT) for conventional pollutants,[113] and best-available technology economically achievable (BAT) for toxic and nonconventional pollutants.[114] The EPA may also issue best management practices (BMPs) to supplement ELGs for industries in a class or category of point source.[115] If there are no ELGs promulgated for a particular industry then the state environmental agency or the EPA is authorized to establish technology-based effluent limitations using best professional judgment (BPJ).[116] The EPA will administer this permit program unless it grants authority to the state to administer the program.[117] The EPA, however, retains oversight responsibility and can compel the state to revise their program or retract permit authority.[118]

A. Federal Regulation of Net Pens

The EPA initially proposed to regulate net pens and CAAPFs in 1973, and, after a lawsuit and consent decree, defined them as a point source in 1979.[119] As a defined point source, CAAPFs needed NPDES permits but

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111. *Id.* § 1314(b).

112. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed. Reg. 51,892, 51,895 (Aug. 23, 2004) (codified at 40 C.F.R. pt. 451).

113. 33 U.S.C. §§ 1311(b)(2)(E), 1314(b)(4)(A).

114. *Id.* §§ 1311(b)(2)(A)-(D), (F); 1314(b)(2)(B).

115. *Id.* § 1314(e) (2000).

116. National Pollutant Discharge Elimination System Permit Regulations, 49 Fed. Reg. 37, 998, 38,025 (Sept. 26, 1984) (codified at 40 C.F.R. pts. 122, 124, and 125); *see* also 33 U.S.C. § 1342(a)(1) (authorizing the EPA to take such action).

117. 33 U.S.C. § 1342(b) ("[E]ach State . . . may submit to the Administrator a full and complete description of the program it proposes to establish and administer . . . . The Administrator shall approve each submitted program unless he determines that adequate authority does not exist . . . ."). "[T]he Administrator . . . shall notify the State of any revisions or modifications necessary to conform to such requirements or guidelines." *Id.* § 1342(c)(1).

118. *Id.* § 1342(c)(3) ("Whenever the Administrator determines . . . that a State is not administering a program approved under this section in accordance with requirements of this section, he shall so notify the State and, if appropriate corrective action is not taken within a reasonable time . . . the Administrator shall withdraw approval of such program.").

119. *See* Natural Res. Def. Council, Inc. v. Reilly, No. 89-2980, 1991 LEXIS 5334, at *3 (D.D.C. Apr. 23, 1991) ("In the early seventies, EPA began to develop effluent guidelines but failed to meet statutory deadlines. NRDC and the Environmental Defense Fund filed suits against the EPA, and in June, 1976[,] the agency entered into a consent decree obligating it to initiate rulemaking proceedings to develop effluent limits, new source performance standards, and pretreatment standards for priority

the reality is that most net pens did not have permits of any kind.[120] This may be because the EPA did not propose any effluent guidelines for CAAPFs for another twenty-three years after the initial designation.[121] The EPA entered into another consent decree in 1991,[122] which eventually brought about the new federal rules for CAAPFs. In between these consent decrees and the new rules, states developed their own effluent limitations and required CAAPFs to obtain state-specific discharge permits. In some states it was still possible to avoid these state-permit requirements if a facility did not meet the EPA's definition of a CAAPF. Naturally then, some companies challenged whether their facility met the CAAPF definition, which would exempt them from any state-specific regulations.

1. Court Challenges to the CAAPF Requirement

The first case to interpret the CAAPF requirements for net pens was *U.S. Public Interest Research Group v. Atlantic Salmon of Maine*.[123] In 2002, Atlantic Salmon of Maine (ASM) challenged the state's authority to regulate ASM's net-pen facilities that produced less than 100,000 pounds of salmon.[124] The ASM argued that because it operated net pens of small sizes that it was not subject to appendix C and did not need to obtain a NPDES permit.[125] The court disagreed and emphasized that regulating net pens under appendix C is consistent with the goals of the CWA—to regulate pollutants—and that the EPA viewed net pens as included in appendix C.[126]

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toxic pollutants."). "The 1979 version of the regulations has not substantively changed . . . ." Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,875 (Sept. 12, 2002) (describing the history of the regulations from 1973 to 1979).

120. *See, e.g.*, Roger Fleming, *Does the Clean Water Act Protect Endangered Species? The Case of Maine's Wild Atlantic Salmon*, 7 OCEAN & COASTAL L.J. 259, 264 (2002) (noting that Maine pens have long operated without permits).

121. *See* Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. at 57,875 ("Prior to today's proposal. EPA had not proposed effluent limitations guidelines and standards for the aquatic animal production industry."). The only permit to be promulgated by the EPA for net-pen facilities before the standardized ELGs appears to have been the permit for Acadia Aquaculture, as discussed *infra* Part II.A.2.

122. *Reilly*, 1991 LEXIS 5334, at *28–*29 (D.D.C. 1991).

123. *Atl. Salmon I*, 215 F. Supp. 2d 239, 251 & n.9 (D. Me. 2002).

124. *Id.* at 249–50, 251 n.8. The ASM operated seven net-pen facilities off the coast of Maine and nearly all produced more than 20,000 pounds of salmon per year but less than 100,000 pounds. *Id.* at 242–43.

125. *Id.* at 249–51.

126. *Id.* at 251 n.8. Notably, the court cites letters written to ASM from the EPA regional office stating that "[ASM's] facilities are required to obtain NPDES permits for the discharge of pollutants." *Id.* at 252.

The Ninth Circuit also had the opportunity to interpret appendix C in 2002. Attempting to determine whether the CAAPF regulations apply to mussels, the court held that the type of aquaculture facility at issue was not intended for regulation under the CWA.[127] The court examined the intent of the CWA and concluded that mussels and their byproducts were not the type of "pollutants" intended for regulation.[128] As an alternate basis for its holding, the court noted that the plaintiff's facility was not regulated under appendix C because it did not receive feed inputs.[129] Both courts looked to the intent of the CWA and drew conclusions that do not appear to follow a literal interpretation of the CAAPF definition but instead read it in the context of the CWA as a whole.[130]

Interestingly, the new federal ELGs depart from appendix C for net pens and only apply the guidelines to net pens that produce 100,000 pounds or more of aquatic animals.[131] In its proposed rule in 2002, the EPA explained that it was not proposing the application of BMPs to smaller facilities because it had not identified any facilities that produced less than 100,000 pounds of animals per year.[132] The EPA also explained the interaction of this regulation and the CAAPF definition. Even if a facility does produce under the 100,000 pounds threshold, that facility would be subject to permit limits based on BPJ if it is a CAAPF.[133] Furthermore, the

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127. Ass'n to Protect Hammersley, Eld, & Totten Inlets v. Taylor Res., Inc., 299 F.3d 1007, 1009, 1019 (9th Cir. 2002)

128. *Id.* at 1016. The CWA defines "pollutant" as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." 33 U.S.C. § 1362(6) (2000). The *Hammersley* court refused to accept that the term "biological material" included potential pollution from mussels. *Hammersley*, 299 F.3d at 1015–16.

129. *See Hammersley*, 299 F.3d at 1018 ("Because Taylor does not add any feed to its rafts or to the surrounding water, its facilities fall under the second exception to CAAPF classification.").

130. The *Hammersley* Court reserved the question of whether biological materials, released in "concentrations significantly higher than natural concentrations," are "'pollutants' under the Act by virtue of their high concentrations" alone. *Id.* at 1017 n.9. This could open the way for certain unregulated aquaculture pollutants (such as dissolved copper from the pen coating) to be regulated separately from any CAAPF classification.

131. Concentrated Aquatic Animal Production Point Source Category, Net Pen Subcategory, Applicability, 40 C.F.R. § 451.20 (2005).

132. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,900 (Sept. 12, 2002).

133. *Id.* The final regulation is consistent with the proposed rule from 2002 on this topic:

> While facilities producing fewer than 100,000 pounds of aquatic animals per year are not subject to this rule, in specific circumstances they may require NPDES permits that include limitations developed on a BPJ basis. An aquatic animal production facility producing fewer than 100,000 pounds of aquatic animals per year will be subject to the NPDES permit program if it is a CAAP as

EPA has the discretion, on a case-by-basis to "designate any warm or cold water aquatic animal production facility [as a CAAPF] upon determining that it is a significant contributor of pollution to waters of the United States."[134]

2. The EPA's Initial ELGs for Net Pens Based on BPJ

In 2002, Acadia Aquaculture operated a salmon net pen system, consisting of a ten pens in Blue Hill Bay, Maine.[135] Maine did not have authority to issue NPDES permits at the time Acadia began operation. The EPA therefore took jurisdiction over the permit and, for the first time, promulgated standards and management practices based on its BPJ.[136]

The final permit that was issued for Acadia Aquaculture recognizes and seeks to implement measures to avoid nearly all of the environmental impacts cited above. The permit mandates that a detailed monitoring program be put into place that samples water quality on a weekly basis at "five meters or less downcurrent" from the net pen system, thereby setting a minimum requirement for dissolved-oxygen saturation.[137] The facility is also required to monitor other water-quality indicators for nutrient enrichment including nitrogen and phosphorus as well as the abundance of phytoplankton in the area, which could be an indication of an algal bloom.[138] The monitoring of phytoplankton must also provide a detailed list of the type of organisms present including those that are more pollution-tolerant.[139] A similar program requires the monitoring of the abundance of life below the net pens. According to the permit, Acadia Aquaculture must

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> defined in 40 CFR 122.24. As explained in the proposed rule, EPA limited the scope of the regulation it was considering to facilities that are CAAPs above this production threshold.

Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed. Reg. 51,892, 51,906 (Aug. 23, 2004) (codified at 40 C.F.R. pt. 451).

134. 40 C.F.R. § 122.24(c).

135. Linda M. Murphy, EPA-New England, Authorization to Discharge Under the National Pollutant Discharge Elimination System for Acadia Aquaculture, Inc., 23 (Feb. 21, 2002) (on file with author) [hereinafter Acadia Permit]. "Because this permit was already in the process of being issued by the EPA before approval of Maine's MEPDES program, the EPA and the State agreed that EPA would complete issuance of the permit after program approval." Fleming, *supra* note 120, at 323.

136. Acadia Permit, *supra* note 135, at 1; *see also* Fleming, *supra* note 120, at 323 (explaining that this was the first permit that the EPA issued for net pen systems).

137. Acadia Permit, *supra* note 135, at 4 & n.1. Other water characteristics measured include dissolved-oxygen concentration, salinity, transparency (which can indicate the presence of algal blooms), and temperature. *Id.*

138. *Id.* at 6; *see also* Staniford, *supra* note 5 ("Increased nutrients will cause nuisance growth of algae outside the farm and will increase the potential for algal blooms.").

139. Acadia Permit, *supra* note 135, at 7–8, 10.

also submit monthly reports indicating the number of fish in its facility and reporting the amount of food that it applies to all its pens.[140] Lastly, the permit contains a detailed, impact-threshold program that sets warning levels for total number of pollution indicators within three "Sediment Impact Zones," located at less than five, five-to-thirty, and over thirty meters away from the system.[141] The permit is remarkable not only for its breadth but also for its stark contrast to the ELGs that the EPA promulgated only two years later.

3. The Enactment of Federal ELGs

On August 23, 2004, the EPA set uniform ELGs with requirements applicable to all categories of aquaculture.[142] The ELGs, however, fail to provide much guidance and do not reflect the EPA's previous actions in the permit for Acadia Aquaculture. No specific recommendations regarding management or monitoring of net pens are given. Only vague narrative recommendations are provided with an emphasis on "efficient feed management and feeding strategies that limit feed input to the minimum amount reasonably necessary to achieve production goals and sustain targeted rates of aquatic animal growth."[143] The regulations state that feed management is implemented to minimize the amount of uneaten food that falls to the bottom of the net pen.[144]

There are some key differences between the proposed effluent limitations and the regulations finally enacted by the EPA. The proposed effluent limitations required a "real-time monitoring system to monitor the rate of feed consumption."[145] The codified regulations, however, provide an assortment of techniques to accomplish feed management and state that:

> These practices *may* include one or more of the following: Use of real-time feed monitoring, including devices such as video cameras, digital scanning sonar, and upweller systems; monitoring of sediment quality beneath the pens; monitoring of

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140. *Id.* at 5.

141. *Id.* at 14–16.

142. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed. Reg. 51,892 (Aug. 23, 2004) (codified at 40 C.F.R. pt. 451); *see also* 40 C.F.R. § 451.11 (2005) (applying BPT for flow-through and recirculating systems); *Id.* § 451.21 (applying BPT for the net-pens subcategory).

143. 40 C.F.R. § 451.21(a).

144. *Id.*

145. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,928 (Sept. 12, 2002).

> benthic community quality beneath the pens; capture of waste feed and feces; or other good husbandry practices approved by the permitting authority.[146]

Providing industry with viable alternatives to accomplish management practices would be an effective practice if the regulations were not extremely vague as to how these monitoring techniques are to be tested or reported. It is also curious, in light of the Acadia Aquaculture permit, that the regulations make accepted practices, such as the monitoring of the benthic organisms below net pens, optional. It is perhaps even more curious that, although the proposed regulations state that the permittee is to "develop and implement practices to minimize potential escape of non-native species," this language is not in the final rule.[147] Instead, relatively uniform regulations have been promulgated regardless of the type of aquaculture facility requiring that the facility undertake regular maintenance, recordkeeping, and training of its employees.[148] Some states, however, had already gone well beyond these simple guidelines in their permitting scheme.

B. State Regulation of Net Pens

States that have received approval to administer their own permitting scheme have the capacity to set more stringent water-quality requirements than federal regulations.[149] States that have the most well-developed permitting regulations for aquaculture are likely those states that have historically relied on the ocean for much of their economic productivity.[150] Many of these regulations find their roots in the EPA's previous guidance with the Acadia Aquaculture permit.

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146. 40 C.F.R. § 451.21(a) (emphasis added). Making these regulations permissive rather than mandatory underscores the EPA's apparent reluctance to tightly regulate net pens.

147. *Compare* 40 C.F.R. § 451.21, *with* 67 Fed. Reg. at 57,920.

148. *Compare* 40 C.F.R. § 451.11 (applying feed management to flow-through and recirculating systems), *with* § 451.21 (applying feed management to net pens).

149. *See* 33 U.S.C. § 1342(b)(1)(A), 2(A) (2000) (allowing states to issue permits that "insure compliance with" federal water-quality standards).

150. *See* Fleming, *supra* note 120, at 326 ("Salmon aquaculture within the range of Maine's salmon rivers is simply a reality and cannot be ignored. The salmon farming industry and the State of Maine have invested substantial resources to develop aquaculture in Maine. Where presently centered, aquaculture provides jobs in local economies with few current prospects for significant economic expansion."); Andrea Marston, Note, *Aquaculture and the Public Trust Doctrine: Accommodating Competing Uses of Coastal Waters in New England*, 21 VT. L. REV. 335, 355–56 (1996) (noting that aquaculture in coastal states is likely to continue to expand because of job loss and a weakened economy caused by the decline of wild fisheries).

1. Maine's Regulations

Maine's aquaculture laws and regulations demand much more monitoring than the federal government. On January 12, 2001, the EPA approved the State of Maine's application to administer the NPDES program.[151] Maine's subsequent aquaculture regulations emphasize regular site visits, consideration of cumulative impacts, and innovative methods to reduce nutrient enrichment.[152] Maine facilities can obtain a lease for aquaculture but only for a maximum of ten years (subject to renewal).[153] Creating limited leases for aquaculture is probably a good idea because it would allow for an area to recover after being subject to the heavy pollutants associated with aquaculture facilities. Maine mandates video surveillance because it shows potential food buildup beneath the pen.[154] When considering whether to allow an aquaculture lease, the Department of Marine Resources (DMR) looks to the anticipated "physical and ecological impact[s] of the project . . . and any adverse effects on the existing uses."[155] The DMR Commissioner may require the applicant to conduct fish and invertebrate surveys and must receive sediment-core analyses.[156] The Commissioner may also collect or mandate the collection of site-specific information including changes in the physical characteristics of the net-pen site, water-column effects, disease incidence, and other information as deemed necessary before approving a net pen system permit.[157] All this information should create a "baseline that will serve as a benchmark for monitoring the effects of farms on sediments, marine organisms, and water quality."[158] The DMR may revoke an aquaculture lease "[i]f aquaculture has been conducted in a manner substantially injurious to marine organisms, if no substantial aquaculture or research has been conducted over the course of the lease[,] or if any condition of the lease has been violated."[159] In addition, in exchange for the lease of a larger aquaculture facility, the DMR requires a fallow period of twelve to twenty-four months

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151. State Program Requirements; Approval of Application by Maine to Administer the National Pollutant Discharge Elimination System (NPDES) Program; Maine, 66 Fed. Reg. 12,791 (Feb. 28, 2001).

152. *See, e.g.*, MAINE POLLUTION DISCHARGE ELIMINATION SYSTEM, GENERAL PERMIT FOR ATLANTIC SALMON AQUACULTURE, *available at* http://digbig.com/4rybj [hereinafter MAINE PERMIT] (providing a description of the basic elements required in a net-pen-aquaculture permit).

153. ME. REV. STAT. ANN. tit. 12, § 6072(1)–(2), (12) (2005).

154. MAINE PERMIT, *supra* note 152, at 14.

155. ME. REV. STAT. ANN. tit. 12, § 6072(4)(D-1).

156. 13-188-2 ME. CODE R. § 10.3.C(2)(a) (2005), *available at* http://digbig.com/4rybk.

157. ME. REV. STAT. ANN. tit. 12, § 6077(2).

158. 13-188-2 ME. CODE R. § 10.3.C(2), *available at* http://digbig.com/4rybm.

159. ME. REV. STAT. ANN. tit. 12, § 6072(11).

(on average) to allow the area beneath net pens to recover from aquaculture activities on previously harvested areas.[160]

Maine created the State of Maine Finfish Aquaculture Monitoring Program (FAMP)—an advisory panel comprised of stakeholders in the aquaculture industry, which coordinates state and federal permit application for net pen systems.[161]

> The primary purpose of the FAMP is to assess the impact of aquaculture farms on the ocean floor and on water quality around the net pens, to enable DMR to determine whether or not the salmon farms are in compliance with the conditions in their leases, and to allow DEP [(the Maine Department of Environmental Protection)] to determine if water quality standards are being met.[162]

Thus, FAMP acts as a supplementary enforcement body.

In an effort to create a more holistic management system, Maine is considering the implementation of "bay management," a program proposed by the Conservation Law Foundation (CLF).[163] Bay management is meant to encourage decision making that "facilitates adaptive management practices" for current and future use.[164] Bay management encourages local participation, shorter feedback loops between industry reporting and regulation, and provides an opportunity for people who live and work around a body of water to think prospectively about the potential impacts that might result from locating net pen systems in their area and to gather data on biological and ecological impacts.[165]

2. Washington's Regulations

Washington State has about thirty years of net-pen experience and an extensive regulatory system in place.[166] The EPA has delegated authority

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160. *Id.* § 6072(13-A). A fallow period refers to "a lease site without cultured fish, shellfish, scallops and gear except marked mooring blocks." *Id.*

161. *Atl. Salmon II*, 257 F. Supp. 2d 407, 417 (D. Me. 2003); *see also* ME. REV. STAT. ANN. tit. 12, § 6080 (authorizing the creation of an aquaculture advisory panel).

162. *Atl. Salmon II*, 257 F. Supp. 2d at 419–20.

163. Conservation Law Foundation, Bay Management, http://digbig.com/4rybn (last visited Apr. 22, 2005).

164. *Id.*

165. Telephone Interview with Roger Fleming, Staff Attorney, Conservation Law Foundation, (Jan. 19, 2006) [hereinafter Fleming Interview] (on file with author).

166. *See generally* KEVIN H. AMOS & ANDREW APPLEBY, WASH. DEP'T. OF FISH & WILDLIFE,

to the Department of Ecology (DOE) to issue NPDES permits for point sources in the state.[167] In 1991, the decision by the DOE to issue a NPDES permit was challenged by a group called the Marine Environmental Consortium (MEC).[168] The DOE settled to develop uniform procedures and standards applicable to net pens.[169] The Washington legislature ordered the DOE to promulgate standards for aquaculture waste, including a plan "for allowable sediment impacts from organic enrichment due to marine finfish rearing facilities."[170]

The Washington regulations break down the artificial CAAPF definition and require all finfish net pens, regardless of size, to meet sediment quality, water quality, and generally approved practices set by the DOE.[171] Washington's regulations for net pen systems also include an extensive monitoring and reporting program to assure compliance with NPDES standards for pollution discharge.[172] This program requires that, prior to operation, the net-pen operator collect a reference sample to determine the area's baseline "benthic infaunal abundance, total organic carbon and grain size in the location of the proposed operation and downcurrent areas that may be potentially impacted by the facility discharge."[173] The net-pen facility must regularly monitor a one-hundred-foot perimeter "sediment impact zone" around the net pen to ensure it meets the baseline criteria for the area.[174] If there is a statistically significant difference in the baseline indicators, remedial action is required.[175] This remedial action may include increased monitoring, maintenance, or closure.[176]

Many believe that even these requirements need to be revised in order to properly regulate net pens in the future. Environmental groups have appealed a number of permits issued to net-pen aquaculture facilities by the DOE. For example, in 1997, the Marine Environmental Consortium (MEC)

ATL. SALMON IN WASH. STATE: A FISH MGMT. PERSPECTIVE (1999), *available at* http://digbig.com/4rybp (discussing the state's regulatory scheme for Atlantic salmon).

167. Approval of Washington's National Pollutant Discharge Elimination System (NPDES) General Permits Program, 54 Fed. Reg. 40,517 (Oct. 2, 1989). Washington therefore institutes state pollution discharge permits. WASH. ADMIN. CODE § 173-220-020 (2005), *available at* http://digbig.com/4rybq.

168. Marine Envtl. Consortium v. Washington, No. 90-102, 1991 WL 137064, at *1 (Wash. Pollution Control Hearings Bd. June 6, 1991).

169. *Id.* at *6.

170. WASH. REV. CODE ANN. § 90.48.220 (West 2004).

171. WASH. ADMIN. CODE § 173-221A-110(4) (2005).

172. *Id.* § 173-204-412 (2005).

173. *Id.* § 173-204-412(3)(a).

174. *Id.* § 173-204-412(4).

175. *Id.* § 173-204-412(3)(b), (4).

176. *Id.* § 173-204-412(4)(b).

claimed that the issuance of a NPDES permits was incomplete because it did not regulate escapes of fish from their net pens.[177] The Water Pollution Control Board (WPCB) found that the MEC did not clearly show that escapees pose a significant risk to native salmon because the scientific data on the risks associated with escapes was inconclusive at the time.[178] The WPCB granted summary judgment for the aquaculture facility because it was unclear whether the escaped fish actually "cause or tend to cause 'pollution'" as required by the CWA.[179]

Earlier in 1998, the WPCB denied MEC's appeal of a previous decision by the WPCB to issue a permit to an aquaculture site. The MEC claimed that the permit did not include "all known available and reasonable methods" of treatment,[180] and argued that the best treatments were "floating bag systems, upland tanks and rigid wall floating tanks."[181] The WPCB agreed that these systems would work to remedy many environmental problems but dismissed the claim because the technology was not yet economically or technologically feasible.[182]

III. SHORTCOMINGS IN THE MANAGEMENT OF AQUACULTURE

The EPA's national aquaculture management policy is inadequate and inconsistent with both the CWA and the parameters set out in the Acadia Aquaculture permit. With its new rules, the EPA claims to have

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177. Marine Envtl. Consortium v. Washington, No. 96-257, 1998 WL 934931, at *3 (Wash. Pollution Control Hearings Bd. Nov. 30, 1998). Under state law, the Water Pollution Control Board has jurisdiction to address whether permits are in compliance with state law. WASH. REV. CODE ANN. § 43.21B.110(1)(c) (West 1998 & Supp. 2006).

178. *Marine Envtl. Consortium*, 1998 WL 934931, at *22.

> Using this methodology, we also note that the level of risk will differ depending on the focus of the question. If the question of risk posed by escaping Atlantic salmon is focused on the entire Pacific salmonid species, the risk is far less than if the question is focused on one particular stock on the brink of extinction. In the latter case, a stock with only a few remaining individuals breeding in a particular stream would face a significant, perhaps overwhelming risk, if even one of the female's redds is spawned on by a precocious Atlantic parr. Assuming ten individuals, five males and five females, such an event would affect 20 percent of the reproductive output of that particular population. Thus we see a much higher risk to particular stocks of native salmon than we do for Pacific salmon as a whole. For reasons discussed below, we do not find that escaping Atlantic salmon now pose a significant risk to Pacific salmon in Puget Sound.

Id. at *5.

179. *Id.* at *22.

180. Marine Envtl. Consortium v. Washington, No. 96-257, 1998 WL 377649, at *1 (Wash. Pollution Control Hearings Bd. June 1, 1998); *see also* Wash. Rev. Code Ann. § 90.48.010 (West 2004) (requiring "all known available and reasonable methods").

181. *Marine Envtl. Consortium*, 1998 WL 377649, at *1.

182. *Id.* at *4–*5.

"establishe[d] technology-based narrative limitations and standards for wastewater discharges from new and existing [CAAPFs] that discharge directly to U.S. waters."[183] In reality, however, the regulations provide neither clear guidelines nor definite standards for CAAPFs.

A. No Pollution Indicators

The final rule relies almost entirely on BMPs to regulate net pen systems.[184] There is no requirement for any effluent monitoring.[185] In other words, no warning thresholds, water-quality-based pollution indicators, or other measurable impact standards are established that would allow for enforcement of pollutants from permitted facilities.

The EPA relies on "feed management and operational BMPs" to treat the pollution produced by net pens.[186] The specifics of the BMP plan are left to the CAAPF industry.[187] The only data that is required to be reported in the BMP plan is what kind of system they are using for feed management and certain "extralabel" drug use.[188] The reliance on BMPs is contrary to the CWA, which allows for BMPs not as replacements to effluent-limitations standards but in conjunction with them.[189]

The primary protection that the EPA envisions for net pens' environmental impact appears to be efficient feed management.[190] But the

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183. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed. Reg. 51,892, 51,892 (Aug. 23, 2004) (codified at 40 C.F.R. pt. 451 (2005)).

184. *See* Letter from SeaWeb, Environmental Defense, Clean Water Network members, and other interested parties, Comments on Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, to EPA, (Jan. 27, 2003) [hereinafter SeaWeb Comments] (on file with Vermont Law Review) (responding to the originally proposed regulations in Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872 (Sept. 12, 2002)). The proposed regulations separate BMPs into a separate subsection; however, the codified regulations incorporate BMPs, virtually unchanged, into BPT requirements. *Compare* 40 C.F.R. 451.21 (providing BPT requirements for net pens), *with* 67 Fed. Reg. at 57,928 (providing net-pen effluent limitations achievable through BMPs).

185. 69 Fed Reg at 51,912.

186. *Id.* at 51,900.

187. *See id.* at 51,901 (stating that "[t]he BMP plan is a tool in which the facility must describe the operational measures it will use to meet the non-numeric effluent limitations in the regulation. . . . [T]he CAAP facility owner or operator will be expected to develop site-specific operational measures that satisfy the requirements.").

188. *Id.* Drug use will need to be reported if it "exceed[s] the approved dosage" but "EPA anticipates that most extralabel drug use will not require reporting." *Id.*

189. 33 U.S.C. § 1314(e) (2000).

190. 40 C.F.R. § 451.21(a). "[P]ractices may include one or more of the following: Use of real-time feed monitoring . . . ; monitoring of sediment quality beneath the pens; monitoring of benthic community quality beneath the pens; capture of waste feed and feces; or other good husbandry

food that falls to the bottom of the net pens causes environmental impacts that will be unaffected by a monitoring device without a way to eliminate the food that inevitably accumulates. Even with efficient feed management, other environmental impacts continue unabated and include large quantities of fish waste, disease, algal blooms, escapes, and chemical use.

The EPA claims to have rejected numeric effluent limitations because it would be prohibitively costly for net pens, requiring sophisticated "physical wastewater control systems."[191] Clearly, a complete containment system for net pens is impractical because of cost. That should not, however, prevent the EPA from establishing baseline monitoring and reporting on measurable environmental impacts.

Requiring monitoring and reporting of the environment around net pens, the approximate number of escapes, and the quantity of medication and chemicals need not be expensive. The EPA recognizes very little if any cost to require the use of feed monitoring as it is already used by most net-pen facilities to reduce the cost of feed.[192] The EPA already requires that net pens "report any failure of or damage to the structural integrity of the containment system that results in a material discharge of pollutants to the waters of the U.S."[193] This is meant primarily as a reporting requirement for major fish escapes due to the failure of the pens after storms and the like. If facilities are already required to report certain events, then other events—such as small-scale escapes and pollution in the surrounding environment—can also be reported. Requiring regular monitoring and reporting for other identifiable forms of pollutions would provide the EPA a baseline upon which to checkup now and again on the environmental effects of this relatively new industry. Moreover, public comments to the proposed regulations emphasize that the EPA should require facilities to monitor not only directly under the net pen but also in nearby sediments, indicator organisms, and the water column for signs that pollutants are being discharged from the net pens or bioaccumulating at levels that could impact the environment or human health.[194]

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practices . . . ." *Id.* The regulation also lists waste collection and disposal, transport or harvest discharge, carcass removal, materials storage, maintenance, recordkeeping, and training. *Id.* § 451.21 (b)–(h). None of these provide any concrete standards.

191. 69 Fed. Reg. at 51,910.

192. *Id.* at 51,911.

193. *Id.* at 51,901.

194. Letter from Nat'l Envtl. Law Ctr. and U.S. Pub. Interest Research Group, Comments on Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, to EPA (Feb.12, 2004) [hereinafter NELC Comments] (on file with *Vermont Law Review*).

B. Insufficient Monitoring and Reporting

In order to calculate or predict the expected impacts accurately, the EPA must ensure that monitoring occurs, both at the beginning of the operation and as it evolves.[195] Maine and Washington have already incorporated many of these practices into their permits,[196] and there is some consensus that the monitoring of sediments represents the best way to mitigate the environmental impacts of net pen systems.[197] The CWA specifically allows for monitoring needed to comply with applicable water quality standards and effluent limitations.[198] Yet the new rule's BMPs do not require the approval of management plans nor the regular monitoring and reporting of environmental impacts. Although apparently recognizing the environmental impacts associated with aquaculture in the proposed rule,[199] the final rule leaves it largely up to the industry to self-regulate in the keeping of feed records and preventing chemical spills.[200] Despite a mandate for industry to establish practices to minimize escapes in the proposed rule,[201] there exists no comparable requirement in the final rules.

Self monitoring in any respect does not facilitate a good management plan for CAAPFs. Land-based factory farms, known as "concentrated animal feed operations" (CAFOs),[202] continue to be inadequately regulated by the EPA because they largely rely on self monitoring.[203] CAAPFs regulate "industrial aquaculture, [which is] a process driven by the same economics that govern terrestrial factory farms."[204] Experience with the regulation of agriculture should make it clear that self monitoring is not the way to achieve environmental compliance. As one court noted:

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195. Kai N. Lee & Jody Lawrence, *Adaptive Management: Learning from the Columbia River Basin Fish and Wildlife Program*, 16 ENVTL. L. 431, 446 (1986).

196. *See* ME. REV. STAT. ANN. tit. 12, § 6077 (Supp. 2006) (setting forth an aquaculture-monitoring program in which the state may collect data on categories that include "geophysical site characteristics," "water column effects," and "disease incidence"); WASH REV. CODE ANN § 90.48.220 (West 2004) (requiring a sediment-monitoring program);.

197. *See, e.g.*, GOLDBURG ET AL., *supra* note 28, at 26 (recommending a monitoring program).

198. *See* 33 U.S.C. § 1341(d) (2000) (allowing monitoring requirements to be included in NPDES permits).

199. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,910–12 (Sept. 12, 2002).

200. 40 C.F.R. § 451.21 (2005).

201. "The permittee must develop and implement practices to minimize the potential escape of non-native species." 67 Fed. Reg. at 57,928.

202. 40 C.F.R. § 122.23.

203. *See* Jerger, *supra* note 11, at 128 (arguing that self monitoring is contrary to the intent of the CWA).

204. Belton, *supra* note 91, at 36.

> It is naïve in the extreme to believe that profit driven, commercial enterprises, will generally gratuitously seek to overcome the inertia against meeting ill-defined environmental requirements . . . . It is expressly to combat such inertia that Congress enacted the CWA: to provide for the development and application of a comprehensive, scientifically based, and equitably framed regulatory protocol that would, with meaningful enforcement, permit such activities as aquaculture . . . while requiring proper observance of the conditions required to maintain the health of the environment.[205]

Without a clear management plan that incorporates monitoring for the violation of key thresholds, the aquaculture industry will continue to slowly suffer setbacks from profit-hungry entrepreneurs and the ocean ecosystem will become a laboratory for uncontrolled experimentation.

The EPA has failed to provide any real incentives to net pen system operators to reduce environmental impact. Instead, the EPA appears to have embraced the age-old mantra that "the solution to pollution is dilution" when it comes to net pens. Instead of requiring monitoring or water-quality-based effluent limitations to address the concentration of pollutants around net pens, the EPA recommends that net pens be placed in areas that have good circulation and current.[206] In the words of the EPA, "[g]ood water exhange ensures good water quality for the animals in the nets. It also minimizes the concentration of pollutants below the nets."[207] Astonishingly, in locations of good water circulation, the EPA will even forgive any need for active feed monitoring.[208] "[T]he idea that offshore currents will disperse nutrients from fish [waste] so fully as to make them disappear is little more than wishful thinking."[209]

A lack of planning by colonial agriculturalists in New England led to deforestation, overgrazing, erosion, watershed changes, and eventually soil exhaustion.[210] These environmental impacts contributed to the relatively

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205. *Atlantic Salmon II*, 257 F. Supp. 2d 407, 430–31 (D. Me. 2003).

206. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed. Reg. 51,911 (Aug. 23, 2004) (codified at 40 C.F.R. pt. 451). In the proposed rule, the EPA states that these areas should be "well flushed" but apparently not liking the metaphor to "flushing" deleted this language. 67 Fed. Reg. at 57,890.

207. 69 Fed. Reg. at 51,911.

208. *Id.* at 51,910 ("[C]urrents may prevent significant accumulation of uneaten feed such that active feed monitoring is not needed.").

209. Belton, *supra* note 91, at 36.

210. WILLIAM CRONON, CHANGES IN THE LAND 149–50 (1983).

short life of agriculture in New England.[211] The aquaculture industry is destined for a similarly short life and continued damage to the environment if it continues to follow in the footsteps of agriculture. In the open ocean, however, there is no telling what the consequences will be and the solution may not be as easy as moving elsewhere.

Even those who publicly defend net pens believe that the EPA is regulating aquaculture the wrong way by not encouraging businesses to locate pens in areas where they can be contained and by not developing well-defined contingency plans.[212] To properly regulate net pens, it is necessary to look to the broader picture and realize that regulators must plan for the industry's expansion and the emergence of potential environmental problems that are as yet unknown or unclear.

IV. ADAPTIVE MANAGEMENT AS A POTENTIAL SOLUTION

Adaptive management is a strategy that emphasizes the uncertainty in environmental planning and makes periodic adjustments to account for unforeseen environmental problems.[213] It is a natural resource policy that emphasizes learning from experience in order to improve our imperfect understanding of natural systems.[214] From this uncertainty and learning, policymakers may implement the adaptive policy that balances the needs of all parties—including wildlife. Adaptive management was first explicitly used in the Columbia River Basin Fish and Wildlife Program.[215] The Fish and Wildlife Program is promulgated by the Pacific Northwest Electric Power and Conservation Planning Council (Council), a regional agency composed of members from all affected states and the Bonneville Power Administration.[216] It was chartered by the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act), which seeks

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211. *See id.* at 150 (concluding that, because of poor management, the "soil became useless for crops").

212. Telephone Interview with Ronald Lavigne, Assistant Dist. Attorney, Wash. State Dep't of Ecology (Mar. 18, 2005).

213. Nat'l Wildlife Fed'n v. Babbitt, 128 F. Supp. 2d 1274, 1281–82 (E.D. Cal. 2000).

214. KAI N. LEE, COMPASS AND GYROSCOPE: INTEGRATING SCIENCE AND POLITICS FOR THE ENVIRONMENT 9 (1993)

215. Lee & Lawrence, *supra* note 195, at 432–33, 435–36; *see also* LEE, *supra* note 214 at 54 (1993) (explaining that although adaptive management was first explicitly applied in the Columbia basin program, it was recognized in the mid-1970s as a way to understand natural systems and later as a management tool). The Fish and Wildlife Program has been revised several times but continues to emphasize adaptive management. NW. POWER PLANNING COUNCIL, COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM 14–15 (2000), *available at* http://digbig.com/4rybr.

216. Pacific Northwest Electric Power Planning and Conservation Act § 4, 16 U.S.C. § 839b (2000).

to simultaneously establish a power plan and to protect fish and wildlife in the region.[217] The Fish and Wildlife Program, a plan mandated by the Northwest Power Act, seeks to assure that the interests of fish and wildlife are adequately represented among the multiple uses of the river by stressing their importance in an overall scheme of adaptive management.[218] Adaptive management has also been used by the State of Oregon for natural resource planning as part of a comprehensive monitoring strategy for native salmon,[219] by the U.S. Fish & Wildlife Service as part of a conservation plan under the Endangered Species Act,[220] by the Forest Service to develop a comprehensive forest plan,[221] and by the Washington State Department of Ecology in assuring compliance with state water-quality standards under the CWA.[222]

A. The Rationale for Adaptive Management in Net Pens

The characteristics of net pens favor adaptive management. First, net pens, being situated directly in the ocean, are part of a larger ecosystem, and the dynamics of how industrial aquaculture will impact the ecosystem in the long-term are still largely unknown. Using an adaptive approach will facilitate ecosystem-based management, which "links functions such as fisheries and land management."[223] Net pens are affected by land-based pollution such as runoff and cumulative impact from other pollution sources.[224] Water conditions vary and aquaculture must be responsive to it. To the extent that variations are predictable, adaptive management would allow for seasonal and site-specific recommendations based on runoff conditions, weather, and other variables.[225] Net pens present unique problems that require recognition of our lack of knowledge as to their long-term environmental and cumulative impacts.[226] This is especially true if net

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217. *Id.* § 839b(a)(1)–(2).

218. *Id.* § 839b(h)(1)(A).

219. Or. Natural Res. Council v. Daley, 6 F. Supp. 2d 1139, 1147 (D. Or. 1998).

220. Nat'l Wildlife Fed'n v. Babbitt, 128 F. Supp. 2d 1274, 1281–82 (E.D. Cal. 2000).

221. Forest Guardians v. U.S. Forest Serv., 180 F. Supp. 2d 1273, 1280 (D.N.M. 2001).

222. Port of Seattle v. Pollution Control Hearings Bd., 90 P.3d 659, 678–79 (Wash. 2004).

223. LEE, *supra* note 214, at 62.

224. *See* Craig, *supra* note 21, at 203 (noting that a state-by-state approach to aquaculture will not effectively prevent pollution because of "pollution from far upstream, from landlocked states with no interest in or access to mariculture facilities").

225. *See* Nat'l Wildlife Fed'n v. U.S. Army Corps of Eng'rs, 132 F. Supp. 2d 876, 887 (D. Or. 2001) (describing an adaptive approach to address variations in climate and location on the Columbia River).

226. *See* Kai N. Lee, *Rebuilding Confidence: Salmon, Science, and Law in the Columbia Basin*, 21 ENVT'L L. 745, 785 (1991) (recognizing that adaptive management is appropriate when "what is being managed is a population or ecosystem, not individual organisms or projects").

pens proliferate far offshore, such as in the EEZ, where oversight becomes more difficult.

In its *Code of Conduct for Responsible Aquaculture Development*, the NMFS advises stakeholders to use an adaptive management approach in order to address risk and uncertainty inherent with responsible, offshore aquaculture development in the EEZ.[227] The same should hold true for any net pen system. Management of net pens using an adaptive approach would emphasize "monitoring of pre-agreed parameters, record keeping, and reporting on pre-agreed schedules."[228] These monitoring and reporting requirements would enable practitioners to better detect negative environmental effects associated with aquaculture and adapt accordingly. In addition, "[r]egulations should be flexible and distinguish between aquaculture activities which differ in nature and impact, and consequently may require different regulatory approaches and levels of precaution. Distinctions should be made also regarding the sensitivity and uniqueness of species and ecosystems."[229]

Net pen systems have also brought about a conflict of use over resources, something that adaptive management is uniquely able to address. Scientists argued that, consistent with the Northwest Power Act, adaptive management struck a balance between hydropower, Native American fishing rights, commercial fishing, and the survival of Pacific salmon on the Columbia River.[230] There are similar conflicts of use occurring in aquaculture. Fishermen are concerned that due to the expanding production of fish these operations could "flood the market with cheap fish" and put them out of business.[231] Areas of the ocean previously used by fishermen might also become unavailable as aquaculture facilities move in.[232] Aquaculture is happening now, however, and some believe that it is a "necessity" in order to satisfy the seafood market.[233] This is recognized in Maine's two-year pilot projects in bay management currently being

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227. NAT'L MARINE FISHERIES SERV., A CODE OF CONDUCT FOR RESPONSIBLE AQUACULTURE DEVELOPMENT IN THE U.S. EXCLUSIVE ECONOMIC ZONE 17–18 (2002) [hereinafter NMFS, CODE OF CONDUCT], *available at* http://www.nmfs.noaa.gov/trade/AQ/AQCode.pdf.

228. *Id.* at 18.

229. *Id.* at 19.

230. E-mail from Kai N. Lee, Rosenberg Professor of Environmental Studies, Williams College, to author (Aug. 16, 2005) (on file with *Vermont Law Review*); *see also* LEE, *supra* note 214, at 48–49 (explaining the compromise that lead to the Northwest Power Act).

231. Kate Ramsayer, *"There's Barbed Wire Starting to Go up": Beleaguered Fishermen Worry About Expansion of Fish Farms*, DAILY ASTORIAN (Or.), July 12, 2005, at 1 (paraphrasing Gary Soderston, President of the Columbia River Fishermen's Protective Union).

232. *Id.* at 14.

233. *Id.* For a discussion of the U.S. government's rationale and support for aquaculture, see *supra* notes 22–30 and accompanying text.

implemented by staff at the state planning office and the DMR.[234]

Bay management recognizes an important reality: aquaculture is changing rapidly and requires continuous management and reevaluation in light of possible negative impacts. Similar test projects should be encouraged; experimentation is an important component of adaptive management because it allows for the testing of established hypotheses and learning from experience.[235] The constant evaluation and adjustment based on measurable scientific data would allow resource managers to strike a balance among interest groups' concerns in a nonpolitical, and more flexible, manner.

Lastly, aquaculture is expanding and is expected to grow dramatically in the next few years due to monetary and regulatory incentives.[236] This produces "a mandate to take action in the face of uncertainty," which is an institutional condition that favors adaptive management.[237] The Northwest Power Act directs the Council to rely upon the "best available scientific knowledge," designed to test and improve the scientific basis for action.[238] Similarly, the CWA demands that the EPA rely on ELGs, which use the "best" technology, based on the amount of control that can be (economically) achieved.[239] An adaptive approach to net-pen management would ensure that the EPA fulfills its duty to use the most current and reliable scientific knowledge in order to regulate net pens. This adaptive approach ensures that the technology and management plan are adjusted in order to minimize the environmental impacts and seek sustainability. Therefore, the implementation of an adaptive management approach requires that triggers be established. These triggers place threshold limits for pollutants around the pen and that remediation plans established to address possible effects that this pollution is having.

B. Applying Adaptive Management to Net Pens

For a meaningful application of adaptive management, the regulations for net pen systems must incorporate benchmarks that signal environmental impact and can be used to test management techniques.[240] Such benchmarks represent a "hypothesis to be tested" by the adaptive

234. Fleming Interview, *supra* note 165.

235. LEE, *supra* note 214, at 63 & tbl.3-2.

236. *See supra* Part I.

237. LEE, *supra* note 214, at 63 tbl.3-2.

238. 16 U.S.C. § 839b(h)(1)(A) (2000).

239. *See supra* notes 213–22 and accompanying text.

240. E-mail from Ellen Athas, Director of the Clean Oceans Program, The Ocean Conservancy, to author (Jan. 31, 2005) (on file with *Vermont Law Review*).

management scheme and must first be identified and agreed upon by stakeholders.[241] Practitioners of adaptive management are explicit in their expectations, regularly test the environment, and, based upon this information, change their management strategy appropriately.[242] An adaptive management provision was incorporated into a NPDES permit to anticipate potential environmental consequences after an airport runaway was built on part of a wetland.[243] At every step of the building process a two-step inquiry was required. First, "'through a preponderance of evidence . . . water quality standards [must] be met,' identifying 'areas of uncertainty.'"[244] Second, measures were implemented to "remove or reduce the uncertainty," which included strict monitoring and an adaptive approach that was responsive to changes in expectations.[245]

Maine and Washington incorporate thresholds of environmental impact for enrichment of the seafloor surrounding net pen systems into their permitting schemes. What these states fail to do adequately, however, is look to the future to plan how these impacts might change and to plan how they want to manage the aquaculture industry in each state as a whole. According to the NMFS, applying adaptive management to aquaculture will first require a clear identification of management objectives and the methods by which these objectives "are to be assessed, monitored, and addressed."[246] Objectives should be clearly stated and aimed to avoid all potential environmental impacts associated with aquaculture. For example, a maximum acceptable number of escapes should be tolerated, and if there were more escapes than is acceptable in the area, then different management practices would be necessary. The EPA apparently solicited comments on contingency plans that would minimize escapes and potential disease transmission from net pens but failed to implement any contingency plans in their final rules.[247]

Accoring to the NMFS, adaptive management needs to emphasize "[s]tandards, reference points, pre-agreed actions, contingency plans, and other parameters . . . developed in consultation with stakeholders."[248] This

241. E-mail from Kai N. Lee, *supra* note 230.

242. LEE, *supra* note 214, at 9.

243. Port of Seattle v. Pollution Control Hearings Bd., 90 P.3d 659, 678–79 (Wash. 2004).

244. *Id.* at 671 (quoting the administrative record in the case).

245. *Id.*

246. NMFS, CODE OF CONDUCT, *supra* note 227, at 18.

247. *See* Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 67 Fed. Reg. 57,872, 57,901 (Sept. 12, 2002) (soliciting comments on preventative measures that "minimize escapes and discharges of pathogenic bacteria").

248. NMFS, CODE OF CONDUCT, *supra* note 227, at 18.

kind of management plan is partially being used in state aquaculture permits in Washington State and Maine by their testing of the sediment around the CAAPF net pen for pollution indicators.

1. Adaptive Sediment Management

In the absence of a pipe or a clear discharge point where water quality can be directly measured, pollution can be measured by testing the sediments near net pens and the impact of aquaculture procedures on nontarget organisms. The NMFS recommends such adaptive management and monitoring to assure the health of sediments below and in the vicinity of net pens.[249]

Maine and Washington are using principles of adaptive management in the monitoring of sediment zones below net pens. The "benchmark" sediment-management monitoring used in Maine and the "sediment impact zone" technique used in Washington both serve to establish threshold limits of acceptable nutrient enrichment of the sea floor.[250] When threshold limits are exceeded, appropriate action is taken. This is consistent with adaptive management, requiring that regulations be flexible and responsive to new information.

Unlike the monitoring procedures set up in Maine and Washington, however, a truly adaptive system would focus on the intention of the management procedure in order to discover whether it is working or not.[251] It would look to the broader picture, such as ecosystem health, and formulate hypotheses to determine whether the procedure is working to achieve the stated goals given the experience of managers.[252] Biologists may conclude, for example, that testing animal diversity in the sediment, not just testing for animal abundance, is needed to ensure ecosystem stability.[253] This modified testing procedure would be appropriate if it is necessary to accomplish the stated objective of ecosystem health as measured by a preset standard.

Contingency plans, established by the permittee, must be available and able to be put into play if the preset standards cannot be achieved and to combat potential environmental impacts that have not reached fruition. For

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249. *Id.* at 19.

250. *See supra* Part II.B.

251. Lee & Lawrence, *supra* note 195, at 445.

252. *Id.*

253. The argument to measure for animal diversity was made by Washington environmental groups, but the court deferred to the Washington State Department of Ecology's decision to measure only animal abundance. Marine Envtl. Consortium v. Washington, No. 96-257, 1998 WL 934931, at *13–*14 (Wash. Pollution Control Hearings Bd. Nov. 30, 1998).

example, there is some evidence that the accumulation of waste below net pens eventually will exceed any natural assimilative capacity that the surrounding seafloor may have.[254] This result could be forestalled by issuing net-pen operators larger lease areas in which to practice fallowing. By incorporating shorter feedback loops that would allow for the reporting of sediment diversity and implementation of a contingency plan, operators could avoid the impacts of exceeding capacity before the development of "death zones" in the area. States may consider appointing citizens from diverse backgrounds, such as those appointed by Maine's aquaculture taskforce, to determine if changes in net-pen management are needed to achieve stated goals.

In its public comments on the EPA's proposed aquaculture ELGs, the National Environmental Law Center recommended that adaptive management techniques be implemented because such an approach would "require enforceable, measurable impact standards and warning thresholds on all . . . pollutants of concern." [255] These pollutants include "metals, toxics, or drugs . . . discharged from the net pens, or [that] are bioaccumulating".[256] An adaptive management plan would set thresholds for recognized pollutants, including biological waste and antibiotics, as well as other unacceptable effects on the environment. Sediment below the net pen would then be monitored regularly for organism abundance and diversity as well as chemical and biological waste. If the sediment exceeds any of the established thresholds, remedial action will be necessary. The permitting authority must be notified and an aquaculture specific body (i.e., an Aquaculture Council) must decide what is appropriate, such as mandating a fallow period, restricting the use of a particular medication, decreasing the number of animals in the net pen, or closing the facility altogether.[257]

2. Adaptive Management and Siting Criteria

Adaptive management would work to evaluate and choose areas where net pens should be located, what type of net pens should be located there, and how stringent the permitting should be. Flexible regulation is needed in order to distinguish between variables in the way the net pens could interact

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254. Staniford, *supra* note 5 (noting that this approach is advocated for use in the farming of tuna in South Australia).

255. NELC Comments, *supra* note 194, at 3.

256. *Id.*

257. These are some of the actions that the Department of Ecology has discretionary authority to implement in Washington State's net pen system permits. WASH. ADMIN. CODE § 173-204-412 (2005).

with the surrounding environment. Potential environmental impact is influenced greatly by location. For example, if an indigenous species is farmed in an area where it exists naturally, accidental release may pose more of a threat to the genetic vitality of native species.[258] Therefore, if a net-pen operator attempts to obtain a permit for a fish that has a native population in the area, regulations that prevent escapes should be more stringent as compared to net pens that house fish with no chance of surviving in the wild. Different approaches may be used and "[d]istinctions should be made also regarding the sensitivity and uniqueness of species and ecosystems."[259] Policymakers should be free to consider alternatives that would better contain fish in their net pens including enclosure technologies that might represent a viable solution once the true cost of poorly managed fish farming are revealed and the potential benefits from properly maintained net pens become clear.[260]

Many recognize the importance of siting when managing CAAPF net pens. The final rules state that "consideration of location is critical in predicting the potential impact the net pen will have on the environment."[261] Unlike the EPA's recommendation, however, which seems to favor siting net pens in areas with high water exchange, at least one practitioner recommends the opposite approach. Accoring to Ron Lavigne, an Assistant District Attorney at the Department of Ecology, the aquaculture industry should be encouraged to move closer to shore so that it can be more easily contained and monitored.[262] Siting all net pens in areas with high levels of water exchanges may actually cause or contribute to the algal blooms if aquaculture pollution is all coming from the same "favorable" locations because they are encouraged to site there.[263] As net pens continue to multiply and the industry continues to grow, an adaptive approach that takes into account the environmental characteristics of the ecosystem and the capacity to control the discharge of pollution makes sense.

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258. Naylor et al., *supra* note 59, at 429–30.

259. NMFS, CODE OF CONDUCT, *supra* note 227, at 19.

260. *See* Marine Envtl. Consortium v. Washington, No. 96-257, 1998 WL 377649, at *1 (Wash. Pollution Control Hearings Board June 1, 1998) (granting the Department of Ecology's motion to dismiss because enclosure technologies were not currently feasible but noting that such technologies were "promising".).

261. Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, 69 Fed. Reg. 51,892, 51,911 (Aug. 23, 2004).

262. Telephone Interview with Ronald Lavigne, Assistant Dist. Attorney, Wash. State Dep't of Ecology (Mar. 18, 2005).

263. Staniford, *supra* note 5 (noting that "nutrient enrichment of the water body for a longer period could stimulate the growth of phytoplankton.").

CONCLUSION

Current standards set by the EPA to manage aquaculture are inadequate to address the environmental impacts associated with net pen systems and fail to meet the standards that the CWA demands. The aquaculture industry is rapidly growing and net pens will continue to populate the U.S. coastline. The National Offshore Act will likely expand this industry into the EEZ without any safeguards for probable environmental impacts. If net pen systems are not managed properly, then aquaculture is destined to repeat the problems associated with industrial agriculture and cause environmental disaster. It is therefore necessary that a comprehensive management plan be adopted now, and it must be one that can adapt to changing circumstances and seek to mitigate environmental damage by careful planning, monitoring, and reporting. Adaptive management is a technique that emphasizes learning from uncertainty through regular monitoring, reporting, and periodic adjustment. This management scheme is consistent with the goals of the CWA and similar concepts have been advocated by the NMFS as well as the CLF. The EPA must apply a meaningful and adaptive plan to manage the expansion of aquaculture. Our ocean environment depends on it.

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