

Fordham Environmental Law Review

Volume 8, Number 3

2011

Article 8

Ocean Aquaculture

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OCEAN AQUACULTURE

Ronald J. Rychlak*

I. INTRODUCTION

The ocean's resources were once thought to be limitless, and fishing activities were largely unregulated.¹ Overwhelming evidence that these resources are being exploited beyond their natural capacity has forced us to change these perceptions.² Almost everyone now agrees that depletion of the world's fisheries is one of the most pressing environmental issues of our time.³ In fact, international law now requires that nations "take measures which are designed, on the best scientific evidence available to the States concerned, to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield."⁴

The United States has been attempting to improve its fishery stocks for many years, but the effort has not been completely successful. George's Bank, off the New England coast, was once

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1. See HUGO GROTIUS, *THE FREEDOM OF THE SEAS* 28 (Ralph Van Deman Magoffin trans., Oxford Univ. Press 1916); see also LLOYD TIMBERLAKE, *ONLY ONE EARTH* 78 (1987).

2. See, e.g., *United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks, Some High Seas Fisheries Aspects Related to Straddling Fish Stocks and Highly Migratory Fish Stocks*, U.N. GAOR, U.N. Doc. A/CONF.164/INF/4 (1993) (constraints on international fishing).

3. Even those who do not agree that other environmental emergencies are at hand, acknowledge the "deplorable state of global fisheries." Ronald Bailey, *Prologue: Environmentalism for the Twenty-first Century*, in *THE TRUE STATE OF THE PLANET* 1, 4 (Ronald Bailey ed., 1995) [hereinafter *TRUE STATE*]; see also R.L. Swanson et al., *Ocean Pollution is Manageable*, in *THE ENVIRONMENT: OPPOSING VIEWPOINTS* 63, 64 (A.E. Sadler ed., 1996) [hereinafter *OPPOSING VIEWPOINTS*] ("[T]he persistent environmental stresses that the marine environment faces . . . do not bode well for the health of the ocean").

4. United Nations Convention on the Law of the Sea, Dec. 10, 1982, S. TREATY DOC. NO. 103-39, 21 I.L.M. 1261 [hereinafter *UNCLOS*]. See generally John A. Duff, *UNCLOS and the New Deep Seabed Mining Regime: The Risks of Refuting the Treaty*, 19 SUFFOLK TRANSNAT'L L. REV. 1 (1995).

among the world's most productive fishing areas.⁵ Today it is essentially shut down,⁶ and other domestic fisheries are threatened.⁷

"[A]fter thousands of years of extensive human use, during which most assumed the ocean's bounty was limitless, many of the ocean's resources have been seriously damaged or depleted by short sighted practices. In particular, time is running out for certain fisheries that are being badly mismanaged."⁸ Many species of marine mammals are also facing serious population declines.⁹

The public's demand for seafood (and the opposing need for protection of sea life) has dramatically increased over the past ten years and is expected to increase by as much as two thirds over the next ten years.¹⁰ Ocean fishery resources, however, have not kept pace. "Every species of food finfish in the United States' marine waters is now fished at or above its capacity to replace itself."¹¹

5. See Michael De Alessi, *Fish Policy Failure*, CEI UPDATE (Competitive Enterprise Inst.), Nov. 1996, at 3.

6. In 1994, the U.S. Government shut down portions of George's Bank due to fishery depletion. See Jonathan Adler et al., *Benchmarks: The Ecological and Economic Trends That are Shaping the Natural Environment and Human Societies*, in TRUE STATE, *supra* note 3, at 393, 422; Christopher B. Daly, *New England Fishermen Crying Foul: Industry Woes Ties to Government*, *Greed*, WASH. POST, Dec. 14, 1994, at A3.

7. See Carrie A. Tipton, *Protecting Tomorrow's Harvest: Developing a National System of Individual Transferable Quotas to Conserve Ocean Resources*, 14 VA. ENVTL. L.J. 381, 391 (1995) ("Despite the passage of the Magnuson Act, the health of fisheries nationwide continued to drop.").

8. Kent Jeffreys, *Rescuing the Oceans*, in TRUE STATE, *supra* note 3, at 295, 297.

9. See Adler et al., *supra* note 6, at 422.

10. See U.S. DEP'T AGRIC., THE POTENTIALS OF AQUACULTURE: AN OVERVIEW AND BIBLIOGRAPHY 3 (1989) [hereinafter POTENTIALS].

11. *Id.* at 2. While people in the fishing industry have generally seen aquaculture as a threat to their industry, the observation about overfishing highlights an important area where the two industries can work together. For instance, salmon, the most valuable fishery in the United States, depend on the release of millions of smelts produced at various hatcheries. Research is currently being undertaken (and in some areas, projects are underway) in which aquaculture operations

Increasing human population and improvements in fishing technologies have led to over-fishing in many coastal areas. Moreover, the problem has been magnified because the larger, older fish are generally the first to be captured; this has a negative impact on the sustainability of the fishery because the older ones are most likely to be prolific.¹²

Depletion of ocean resources is not limited to the United States.¹³ "[D]epletion of various stocks has occurred in virtually every coastal state in the world."¹⁴ The worldwide fish catch grew steadily from about 1972 until 1989.¹⁵ Commercial harvest from ocean fisheries grew from approximately eighteen million metric tons in the late 1940s to well over eighty million metric tons by the late 1980s.¹⁶ Counting non-commercial fishing, the harvest is well over one hundred million metric tons per year,¹⁷ an increase of more than 50% from two decades ago.¹⁸ It has, however, declined since 1989,¹⁹ and signs of overexploitation are evident.

produce fingerlings for stock enhancement of other species, including haddock, halibut, and turbot. See David J. Harvey, *Farmed-Raised Salmon: Impacts on U.S. Seafood Trade*, in ECONOMIC RES. SERV., U.S. DEP'T OF AGRIC., AQUACULTURE: SITUATION AND OUTLOOK REPORT 23 (March, 1991) [hereinafter AQUA-6]. Many aquaculture operations in the Midwest produce fingerlings for stocking ponds and lakes, as opposed to producing fish that are to be sold for food purposes. See Margaret R. Grossman & Randall E. Westgren, *Aquaculture in Illinois: The State and Federal Legal and Regulatory Environment*, 1982 S. ILL. U. L.J. 193, 193-194 n.1 (1993). See generally Ronald J. Rychlak & Ellen M. Peel, *Swimming Past the Hook: Navigating Legal Obstacles in the Aquaculture Industry*, 23 ENVTL. L. 837 (1993).

12. See Jeffrey, *supra* note 8, at 306.

13. See *id.* at 298.

14. Tipton, *supra* note 7, at 409.

15. See Adler et al., *supra* note 6, at 423.

16. See Jeffrey, *supra* note 8, at 296. In addition, an estimated 24 million tons is also annually taken by local fisherman. See *id.*

17. See GREGG EASTERBROOK, *A MOMENT ON THE EARTH: THE COMING AGE OF ENVIRONMENTAL OPTIMISM* 645 (1995). For at least 25 years, most experts in the field have agreed that one hundred million tons is the approximate maximum sustainable harvest. See Jeffrey, *supra* note 8, at 300.

18. See Adler et al., *supra* note 6, at 422.

19. See *id.*

"After years of official denial, the trend of fishery] closures accelerated in 1994."²⁰

The typical approach to sea life protection has been to regulate harvests by imposing restrictions and controls on fishing activities. Regulations as to net type, boat sizes, and other technological aspects of the fishing industry are common. Regulators in Canada and the United States have imposed moratoriums and bans on fishing certain stocks.²¹ Thus, the season may be shortened,²² catch may be limited, or fishing techniques (e.g. drift nets) may be prohibited.²³ Unfortunately, these measures have had very limited success. Consider the following example:

When limits on the length of the fishing season for Alaskan halibut were implemented a few years ago, fishermen reacted predictably - they figured out how to catch fish more quickly. Each side upped the ante, and before long the season was only two days long. Throughout this ordeal the catch remained essentially unchanged, but fishing became more and more dangerous, and the availability of fresh, quality fish disappeared.²⁴

Each fisherman "has an incentive to collect as much of the fishery resource as possible, because the escapable nature of the re-

20. Jeffreys, *supra* note 8, at 306.

21. *See id.*; EASTERBROOK, *supra* note 17, at 645.

22. According to one report, the season for Herring Roe in Alaska has been as brief as forty minutes. *See* Jeffreys, *supra* note 8, at 313 (citing *The Tragedy of the Oceans*, *ECONOMIST*, Mar. 19, 1994, at 22); *see also* De Alessi, *supra* note 5, at 3 (Alaskan halibut season down to two days).

23. *See* EASTERBROOK, *supra* note 17, at 645. Perhaps the most important federal response to marine resource management problems is the Magnuson Act. [Magnuson-Stevens Fishery Conservation and Management Act of 1976, Pub. L. 94-265, 90 Stat. 331 (codified as amended in scattered sections of 16 U.S.C.).] The goal of this act is to restrict the access of foreign fleets to U.S. coastal waters and to increase the federal government's authority to regulate the American Fishing Industry. Under this Act, the federal government collected more reliable data on fishery stock conditions, the effects of fishing on various species, and restricted harvest levels to a calculated sustainable yield. However, out of eighty-one managed fishery stocks examined by the National Fish and Wildlife Foundation early this decade, fourteen were considered to be over exploited, and another thirty-six were being fished at their maximum capacity. *See* Jeffreys, *supra* note 8, at 321-22 (citing a 1991 study).

24. De Alessi, *Fish Policy Failure*, *supra* note 5, at 3.

source combined with the lack of tangible, divisible property rights for fishery participants ensures that any fish not collected by one fisherman will be collected by another.²⁵ It is this treatment of the oceans as a "commons" that turns drift nets into logical technological devices.²⁶ "The worldwide problem of overfishing has its source in the regime of open access and free use, with its norm that only capture confers ownership of fish."²⁷ Or as another author put it, we have seen the "reduction of a once-rational industry to a 'madcap derby' [as a result of the current] management system . . ."²⁸ Too often, those seeking solutions to the current situation "fail to realize that the problem lies in the commons, not the herdsman."²⁹ It is time to consider new solutions to this continually worsening problem.

II. AQUACULTURE'S ROLE IN OCEAN FISHERIES

One possible solution to the fish shortage is aquaculture. It is unlikely that one will ever hear a commercial aquaculturist complain that his or her pond has been over-fished and that is why the harvest is low.³⁰ Aquaculturists protect their crop and have a clear economic incentive to keep the fish supply strong and

25. Tipton, *supra* note 7, at 382.

26. See Jeffreys, *supra* note 8, at 312. "The tragedy of the commons is alive and well" in our nation's fisheries. De Alessi, *supra* note 5, at 3; See also EASTERBROOK, *supra* note 17, at 645; Bailey, *supra* note 3, at 4 (overfishing directly analogous to the tragedy of the commons); CEI Environmental Briefing Book, *The Unexplored Virtues of Private Conservation* (visited Nov. 18, 1997) <<http://www.cei.org:80/ebb/privcon.html>>. In his Keynote Address to this symposium, Paul C. Pritchard discussed the elimination of bison from the American West - also a tragedy of the commons. See Paul C. Pritchard, *Our National Parks: Assumptions, Metaphors and Policy Implications*, 8 FORDHAM ENVTL. L.J. 421 (1997).

27. Jeffreys, *supra* note 8, at 306 (citing SEYOM BROWN ET AL., REGIMES FOR THE OCEAN, OUTER SPACE, AND WEATHER 104 (1977)); see also Michael De Alessi, *Emerging Technologies and the Private Stewardship of Marine Resources* (Executive Summary) <<http://www.cei.org:80/marine.html>> [hereinafter De Alessi, *Emerging Technologies*] ("Maintaining open access to marine resources encouraged fishermen to develop technologies that "vacuumed" the seas").

28. Tipton, *supra* note 7, at 398.

29. Bailey, *supra* note 3, at 4.

30. If this were the case, absent criminal acts, it would be the aquaculturist's own fault.

healthy. The trick is to create a similar incentive for the protection of ocean fisheries.

The art of rearing aquatic organisms,³¹ was developed in China between 3500 and 4000 years ago,³² but because of the historically abundant natural catch, the practice lagged in the United States.³³ In the 1970s, many American fisheries reached maximum sustainable yields and some were overexploited. During this time, aquaculture began to receive focused attention,³⁴ culminating with passage of the National Aquaculture Act ("NAA") in 1980.³⁵ The NAA recognized the aquaculture industry as a source for "augmenting existing commercial and recreational fisheries . . . and for producing other renewable resources, thereby assisting the United States in meeting its future food needs and contributing to the solution of world resource problems."³⁶ Since that time, aquaculture has become a thriving industry in many states.³⁷ Most trout and catfish served in this nation's restaurants, as well as a significant portion of crawfish and oysters, are now farm raised.³⁸ Abalone, salmon, and shrimp are

31. In the United States most aquaculture involves animal life; in other parts of the world, particularly Asia, plant life is an important part of the aquaculture industry. 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." 16 U.S.C. § 2802(1) (1994).

32. See ROBERT R. STICKNEY, *PRINCIPLES OF WARMWATER AQUACULTURE* 5 (1979). Asia remains the world's leading aquaculture area, producing about 81 percent of the world's aquaculture harvest. China, Japan, the Republic of Korea, and the Philippines are the four leading aquaculture countries. See POTENTIALS, *supra* note 10, at 5.

33. See Grossman & Westgren, *supra* note 11, at 193.

34. See FLORIDA DEPARTMENT OF AGRICULTURE & CONSUMER SERVICE, *FLORIDA AQUACULTURE REGULATORY SOURCEBOOK 1-1* (1990).

35. 16 U.S.C. §§ 2801-2810 (1994 & Supp. I 1995).

36. *Id.* § 2801(c).

37. During the 1980s, production of the three primary aquaculture products (shrimp, salmon, and catfish) increased by triple digit levels. See AQUA-6, *supra* note 11, at 3. See generally Rychlak & Peel, *supra* note 11. "Aquaculture production increased by approximately 65 percent between 1984 and 1991 . . ." Adler et al., *supra* note 6, at 424.

38. See Adler et al., *supra* note 6, at 422.

also cultivated in various aquaculture programs.³⁹ Aquaculturists have been very successful in keeping this nation's kitchens, restaurants, and grocery stores well-stocked. In addition, to the extent that aquaculture reduces the demand for ocean fish, it helps fish stocks in the oceans. If, however, the goal is not simply to increase a food source, but to restore depleted ocean stocks, aquaculture as it is currently practiced in this country will not work. In order to harvest the fish that they develop, aquaculturists need to keep the fish in a confined area.⁴⁰ Thus, they either build artificial ponds that have no access to the open sea, or they keep the fish in a silo or other man-made device that is both contained and easy-to-harvest.⁴¹

Freshwater catfish farming currently accounts for forty-five percent of the total aquaculture output in this nation.⁴² While freshwater aquaculture currently dominates the market, the oceans hold great potential for expansion of the aquaculture industry.

39. See Jeffreys, *supra* note 8, at 325.

40. See Tipton, *supra* note 7, at 383 ("Under the Olympic system of national fisheries management, a fisherman's property rights in a fish do not vest until the fish is lying on the deck of his boat.").

41. Two primary methods of culture used in the aquaculture industry are the static method and the flowing method. The most common form of the static method is pond culture. This involves raising the fish in artificial "ponds" and harvesting them. Common forms of the flowing method use tanks, raceways, silos, and cages, with a continuous flowing source of water through these rearing chambers. If the water flowing through these chambers is not recirculated within a self-contained system, the process is an open flowing system; whereas, one which recirculates the water within a self-contained system is a closed flowing system. Population intensity varies significantly with these different systems, with pond culture being less intensive and flowing systems more intensive. Increased population intensity adds to water quality deterioration and resultant diseases. Moreover, open flowing systems use enormous amounts of water. Recirculating systems have the advantage of using less land and water while supporting high density populations. Before the recirculating process can become a major contributor to the aquaculture industry, however, problems relating to disease, cost, and water pollution must be remedied. See Rychlak & Peel, *supra* note 11, at 843 n.39. Hopefully ocean aquaculture, being less confined, could minimize pollution-related problems.

42. See Jeffreys, *supra* note 8, at 326.

Even water which is out-of-sight of land may contain reefs or other identifiable features which indicate permanent locations and attract numerous species of fish. "Along with the creation of new reefs, which increase the size of the fishery resource, it is also possible to treat the ocean as a fertile farm. Cultivating the sea has a great potential to relieve the impact of overharvesting fisheries while simultaneously increasing the food supply."⁴³

The problem with ocean aquaculture is assuring the investor that others will not end up with the harvest. One possibility is a net-pen, constructed from large fishing nets, which can be used both to keep the aquacultural species in and potential predators out.⁴⁴ This, however, is very expensive, potentially damaging to aquatic species, and not very practical. Fortunately, modern fishing regulators are developing ways to do the job better.⁴⁵

III. INDIVIDUAL TRADABLE QUOTAS

One recent innovation is the development of individual tradable quotas ("ITQs") for fishing rights. Like marketable emission allowances which were authorized in the 1990 amendments to the Clean Air Act,⁴⁶ this market trading approach protects the environment while minimizing the role of government.⁴⁷ This type of program recognizes and helps reconcile two potentially conflicting motivations: conservation of valuable marine species before they reach commercial extinction and improvement of the economic performance of the domestic fishing industry.⁴⁸ Such a system reduces incentives for fishermen to engage in

43. *Id.* at 325.

44. *See id.* at 337 n.134.

45. *See* De Alessi, *Emerging Technologies*, *supra* note 27 ("Technologies exist today that could be used to enforce ownership in the marine environment, just as innovations like branding irons and fencing did in the American West.").

46. 42 U.S.C. § 7602(y) (1997).

47. Although there is currently a congressionally-imposed moratorium on implementation, the National Academy of Sciences currently has a study of this concept underway. De Alessi, *supra* note 5, at 3.

48. *See* Christopher D. Stone, *Too Many Fishing Boats, Too Few Fish: Can Trade Laws Trim Subsidies and Restore the Balance in Global Fisheries?*, 24 *ECOLOGY L.Q.* 505, 540-41 (1997); Tipton, *supra* note 7, at 398.

"dangerous, wasteful fishing practices,"⁴⁹ creates incentives to invest in voluntary efforts to protect and conserve fisheries⁵⁰ and also permits environmental organizations to buy and retire some of the fishing rights. Because ITQs involve market forces, they are popular with conservatives, but have been well received by environmental groups across the political spectrum.⁵¹

The most advanced use of ITQs in a national fishing industry is found in New Zealand, where the fisheries have used ITQs since October, 1986.⁵² New Zealand's ITQs are based on a perpetual share of the permissible harvest of a given species.⁵³ Quotas were established based on historical catch levels, and then the government instituted a "buy-back" program that pays fisherman to relinquish fishing rights that exceed the desired goal.⁵⁴ The program has worked well and New Zealand's experience suggests that ITQs provide incentives which can encourage better management of ocean fisheries.⁵⁵

In September 1991, the North Pacific Fisheries Management Council adopted a draft plan for ITQs for Halibut and Sablefish in Alaska.⁵⁶ These fisheries have remained highly productive while fisheries in other areas have fallen upon harder times.⁵⁷ Another Alaskan Halibut fishery was scheduled to convert to an ITQ plan in 1995,⁵⁸ and the results should be in soon.

49. Tipton, *supra* note 7, at 397.

50. *See id.* at 400; Stone, *supra* note 48, at 541.

51. The ITQ concept has been supported in testimony before the United States House of Representatives by the Environmental Defense Fund. *See* Jeffreys, *supra* note 8, at 311.

52. *See* Tipton, *supra* note 7, at 400.

53. *See id.*; Jeffreys, *supra* note 8, at 309-10.

54. *See* Jeffreys, *supra* note 8, at 310. Most regulated fisheries are already limited to a total allowable catch for an annual quota. These numbers are generally based on a calculation of the maximum sustainable yield of the fishery. *See id.* at 333 n.54. If the initial quota catch is set too high, stocks continue to be over-exploited. This initially happened in New Zealand with the Orange Roughy fish, and catch quotas had to be dramatically reduced. *See id.* at 311; *see also* Tipton, *supra* note 7, at 401.

55. *See* Jeffreys, *supra* note 8, at 310; Tipton, *supra* note 7, at 400.

56. *See* Jeffreys, *supra* note 8, at 310.

57. *See id.*

58. *See id.* at 334 n.75.

ITQs may limit the commercial harvesting of fish, but used alone they do little to help re-establish populations that have already been depleted. In order to re-establish fish populations in the ocean, it is necessary to similarly protect and nurture the coastal estuaries which serve as nurseries and breeding grounds for fish and wildlife.⁵⁹ These animals depend on the coastal ecosystems for food and shelter. Unfortunately, to date, there has been little attention directed toward providing an economic incentive to develop these estuaries, even though the tools to do so may be readily available.

IV. THE PUBLIC TRUST DOCTRINE

The Public Trust Doctrine applies to coastal lands affected by the tide and to navigable fresh waters, like rivers and lakes.⁶⁰ These waters and related land masses are often prime breeding grounds for many species of aquatic life. Under this doctrine, coastal property that is subject to the ebb and flow of tidal influences is not owned by the record property owners; it is held by the state as trustee for the people of the state.⁶¹ Generally speak-

59. See Peter Weber, *Ocean Pollution is a Serious Problem, in* OPPOSING VIEWPOINTS, *supra* note 3, at 68, 69-70 ("If we were to declare war against the oceans, the most destructive strategy would be to target the coasts, the regions of most highly concentrated biological activity.").

60. For a general discussion of the Public Trust Doctrine as it relates to navigable fresh waters as well as coastal property, see *Cinque Bambini Partnership v. State*, 491 So. 2d 508 (Miss. 1986), *aff'g sub nom. Phillips Petroleum Co. v. Mississippi*, 484 U.S. 469 (1988). See also M. Casey Jarman, *Of Time, Tidelands, and Public Trust*, 57 MISS. L.J. 131 (1987); Ronald J. Rychlak, *Trace Gases, Equal Footing, and the Public Trust: Ownership of Coastal Properties after the Greenhouse Effect, in* LONG TERM IMPLICATIONS OF SEA LEVEL CHANGE FOR THE MISSISSIPPI AND ALABAMA COASTLINES 22 (Conference, Biloxi, Miss., 1990) [hereinafter Rychlak, *Trace Gases*].

61. The justification with the greatest historical support is that certain interests are so intrinsically important to every citizen that their free availability tends to mark the society as one of citizens rather than of serfs. See *Martin v. Waddell*, 41 U.S. (16 Pet.) 367, 414 (1842). Professor Harrison Dunning's presentation at the symposium discussed the effort of the legislature in Idaho to bring the trust to an end. This is certainly unwise and — I would suggest — illegal under basic trust concepts. See Harrison C. Dunning, *Revolution (and Counter-Revolution) in Western Water Law: Reclaiming the Public Character of Water Resources*, 8

ing, all "navigable waters," the lands beneath these waters, and the living resources inhabiting them are subject to the Public Trust Doctrine.⁶² Courts have almost universally held that "title to the fish within State waters is held by the State in trust for the people of the State."⁶³

The trust establishes the right of the public to enjoy trust waters, lands, and resources through a wide variety of public uses.⁶⁴ As trustee, the state cannot completely alienate the property so as to destroy these rights.⁶⁵ Trust property must not only be used for a public purpose,⁶⁶ but it must be held available for use by

FORDHAM ENVTL. L.J. 439 (1997); *see also* Illinois C. R. Co. v. Illinois, 146 U.S. 387 (1892).

62. In the United States there are 79,481 square miles of inland navigable waters, 74,364 square miles of coastal waters, and an estimated 37,500 square miles of ocean waters within the jurisdiction of the coastal States. This totals approximately 191,000 square miles of navigable waters within the boundaries of the States—roughly equal in size to Maryland, Virginia, North Carolina, South Carolina and Georgia combined—all of which is subject to the Public Trust Doctrine. Further, there are 88,633 miles of trust shoreland. *See* DAVID C. SLADE ET AL., PUTTING THE PUBLIC TRUST DOCTRINE TO WORK 1 (1990).

63. *Id.* at 252; *see also* People v. Monterey Fish Products Co., 234 P. 398 (Cal. 1925).

64. *See generally* Ronald J. Rychlak, *Thermal Expansion, Melting Glaciers, and Rising Tides: The Public Trust in Mississippi*, 11 MISS. L. REV. 95 (1990) [hereinafter Rychlak, *Thermal Expansion*]; Rychlak, *Trace Gases*, *supra* note 60.

65. *See* State v. Cleveland & P.R. Co., 113 N.E. 677, 682 (Ohio, 1916).

The state as trustee for the public cannot, by acquiescence, abandon trust property or enable a diversion of it to private ends different from the object for which the trust was created. If it is once fully realized that the state is merely the custodian of the legal title, charged with the specific duty of protecting the trust estate and regulating its use, a clearer view can be had. An individual may abandon his private property, but a public trustee cannot abandon public property.

Id.

66. *See* Hayes v. Bowman, 91 So. 2d 795, 799 (Fla. 1957).

[T]his title is held in trust for the people for [the] purposes of navigation, fishing, bathing and similar uses. Such title is not held primarily for purposes of sale or conversion into

the general public for particular types of uses.⁶⁷ It has been held "inconceivable" that any person should claim a private property interest in the navigable waters of the United States.⁶⁸ It is, however, possible to dedicate a portion of trust property to private use,⁶⁹ provided the action is in the public interest.⁷⁰

money. Basically it is trust property and should be devoted to the fulfillment of the purposes of the trust, towit [sic]: the service of the people.

Id. One interesting idea is the employment of a "Trust Advocate" who diligently promotes trust interests. See ARIZ. REV. STAT. § 37-1102 (1996).

67. The public's rights preempt the private owner's rights. As a result, any conflict between the exercise of public and private rights is resolved in favor of the public. See JOSEPH K. ANGELL, A TREATISE ON THE RIGHT OF PROPERTY IN TIDE WATERS AND IN THE SOIL AND SHORES THEREOF 33-34 (Rothman 1983) (1926). ("The king, it is true, may grant the soil of any arm of the sea, . . . but the right of the grantee so derived is always subservient to the public rights . . .").

A few courts have completely denied the power of the state to alienate trust property. See Northern P.R. Co. v. Hirzel, 161 P. 854, 860 (Idaho 1916) (railroad not permitted to take title to trust property); Milne v. Girodeau, 12 La. 324, 325 (1838) (land below the high water mark cannot be privately owned); Hodges v. Williams, 95 N.C. 331 (1886); State ex rel. Cates v. West Tennessee Land Co., 158 S.W. 746, 747 (Tenn. 1913); 1 WATERS AND WATER RIGHTS § 36.4(A), at 197 (R. Clark ed., 1967) (citing People ex rel. Harbor Comm'rs. for San Diego Bay v. Kerber, 93 P. 878 (Cal. 1908) (following CAL. CONST. art. XV, § 3)).

68. United States v. Chandler-Dunbar Co., 229 U.S. 53, 69 (1913).

69. The title to trust property has two components: the public's interest (*jus publicum*) and a private proprietary title (*jus privatum*). The *jus publicum* interest cannot be alienated, but the *jus privatum* interest may be conveyed to private ownership. There are limitations on the State's ability to convey the *jus privatum*, but in almost all cases the legislature must find that the conveyance is in the public interest. Once the *jus privatum* interest has been conveyed, the public's remaining interest (known as the public's trust servitude) depends on the State's definition of the trust. In some states the servitude may not include many rights of the public, while in others the bundle of rights held by the public remains so broad, that the private owner's title has been described as a "naked fee." SLADE, *supra* note 62, at 7-8.

70. States clearly may convey a *jus privatum* interest to private ownership, and the public's *jus publicum* interest may under some circumstances be terminated, but it may not be conveyed into private hands.

Trust lands are held in the public trust for various purposes: "The original purpose of the doctrine was to preserve for the use of all the public natural water resources for navigation and commerce, waterways being the principal transportation arteries of early days, and for fishing, an important source of food."⁷¹ The purposes, however, are not fixed. Courts have long recognized that the list of uses would increase with "the growth of the community, and its progress in the arts."⁷² The Public Trust Doc-

See Illinois C. R. Co. v. Illinois, 146 U.S. 387 (1892); *accord* State v. Superior Court of Lake County, 625 P.2d 239 (Cal.), *cert. denied*, 454 U.S. 865 (1981); State *ex rel.* Land Board v. Corvallis Sand & Gravel Co., 582 P.2d 1352 (Or. 1978); Corvallis & Eastern R. Co. v. Benson, 121 P. 418, 422 (Or. 1912); State Land Board v. Heuker, 548 P.2d 1323 (Or. Ct. App. 1976); James River & Kanawha Power Co. v. Old Dominion Iron & Steel Corp., 122 S.E. 344 (Va. 1924) (bed of navigable stream could not be conveyed to private owner); Caminiti v. Boyle, 732 P.2d 989, 992 (Wash. 1987).

71. *See* Neptune City v. Avon-By-The-Sea, 294 A.2d 47, 52 (N.J. 1972). These three purposes have been called "the traditional triad" of public trust rights.

72. *See* West Roxbury v. Stoddard, 89 Mass. (7 Allen) 158, 167 (1863) (noting the rights of navigation, bathing, washing, watering cattle, and other agricultural uses); Lamprey v. Metcalf, 53 N.W. 1139, 1143 (Minn. 1893) (public uses of trust waters are allowed when suitable for use by a group of people having a common interest: . . . "purposes which cannot now be enumerated or even anticipated").

Professor Harrison Dunning, in his presentation at the symposium, discussed how the uses to which the trust is put can shift. *See generally* Dunning, *supra* note 61. Over the years, courts have recognized purposes including fishing, *see* State *ex rel.* Rice v. Stewart, 184 So. 44, 50 (Miss. 1938), navigation and transportation, *see* Rouse v. Saucier's Heirs, 146 So. 291, 292 (Miss. 1933); Martin v. O'Brien, 34 Miss. 21 (1857), commerce, *see* Rouse, 146 So. at 292, bathing, *see* Treuting v. Bridge & Park Comm'n., 199 So. 2d 627, 632-33 (Miss. 1967) (recognizing recreational activities as included within public trust rights); *see also* MISS. CODE ANN. § 49-27-1 (Supp. 1988) (defining "public waterways" and the right of free transport, fishing and water sports reserved to the public), development of mineral resources, *see* Treuting, 199 So. 2d at 633; Cinque Bambini Partnership v. State, 491 So. 2d 508, 512 (Miss. 1986), environmental protection and preservation, MISS. CODE ANN. §§ 49-27-3, -5(a) (Supp. 1985), the enhancement of aquatic, avian and marine life, sea agriculture and other purposes, *see* Dycus v. Sillers, 557 So. 2d 486, 498 (Miss. 1990) (containing an essay on the joys of fishing); *Cinque*

trine has frequently been applied to regulate the exploration, development, and production of oil and gas found on trust lands.⁷³ These conveyances have been viewed as simple permission to explore and produce the resource, subject to the public's continued rights to use the area.⁷⁴

Like oil and gas under trust property, fish are held in trust by the State for the public, and the State is obligated to preserve and protect this trust. Regulations governing the artificial cultivation of fish and shellfish are, therefore, within the scope of the Public Trust Doctrine and should incorporate public trust principles.⁷⁵

The Public Trust Doctrine has traditionally protected the public's right to access to the water for harvesting fish and shellfish. The legislature, therefore, has the authority to pass laws relating to the taking of fish for the purpose of protecting and conserving them.⁷⁶ As such, it is but a "small step" for the doctrine also to be used to encourage activities such as the cultivation of fish, in order to promote or restore their stock.⁷⁷ If the Public Trust can be used to encourage the protection of estuaries and ITQs can be used to restrict unauthorized fishing, it may be possible to restore the populations of at least some coastal fish populations.

A major problem with the encouragement of private development on coastal property is that public access may deprive the investor of any profit from his or her outlay.⁷⁸ Thus, no one would want to develop fish stock in open waters, only to see

Bambini Partnership, 491 So. 2d at 512. See also Rychlak, *Thermal Expansion*, *supra* note 64, at 102-03.

73. See SLADE, *supra* note 62, at 249-52.

74. See *id.* at 249.

75. See *id.* at 252. See R. Prescott Jaunich, *The Environment, The Free Market, and Property Rights: Post-Lucas Privatization of the Public Trust*, 15 PUB. LAND L. REV. 167, 184 (1994) ("Though well-intended, such ill-defined goods allow the free-riding public to suffer while natural resources continue to be degraded."); see also *id.* at 170, 183 (public use of trust property leading to the destruction of valuable resources).

76. See *People v. Monterey Fish Products Co.*, 234 P. 398, 404 (Cal. 1925); SLADE, *supra* note 62, at 252.

77. SLADE, *supra* note 62, at 252.

78. See Jaunich, *supra* note 75, at 184.

competitors harvest the fish. With ITQs, however, it is possible to restrict the harvest to the investor, at least out to 200 miles off the shore.

V. EXCLUSIVE ECONOMIC ZONE

As improved technologies have made fisheries more susceptible to over-harvesting, nations have begun to assert and extended exclusive economic rights farther into the sea.⁷⁹ Accordingly, the two-hundred mile exclusive economic zone (EEZ) is now the accepted international norm.⁸⁰ The American EEZ covers approximately two million square miles and is the largest EEZ of any coastal nation.⁸¹ Ninety percent of the world's living marine resources are now found within EEZs, and almost all fishing takes place within these areas.⁸² Because of this it should be possible to provide protection to coastal aquaculturists, assuring them of a return on their investment.

Under international law,⁸³ coastal nations have the right to

79. The concept of a 200-mile EEZ was the result of an effort to extend this sovereign right to the fisheries near coastal states. See UNCLOS, *supra* note 4, arts. 55-56.

80. Coastal nations have the authority under international law to enforce laws and regulations within their Exclusive Economic Zone (EEZ), which extends 200 nautical miles from the shore of the coastal state. See U.N. DIV. FOR OCEAN AFF. AND THE LAW OF THE SEA, OFF. OF LEGAL AFF., THE LAW OF THE SEA: NATIONAL LEGISLATION ON THE EXCLUSIVE ECONOMIC ZONE at iv, U.N. Sales No. E.93.V.10 (1993). This right is, of course, limited to laws and regulations that are in accord with international law. See TIMBERLAKE, *supra* note 1, at 74; Jeffreys, *supra* note 8, at 318. Interestingly, Japan has exerted a great deal of effort to maintain a small island in the Western Pacific so that it can maintain its EEZ claim over thousands of square kilometers of open sea. See TIMBERLAKE, *supra* note 1, at 74.

81. See Jon L. Jacobson, *International Fisheries Law in the Year 2010*, 45 LA. L. REV. 1161, 1199 n.117 (1985). Slightly over two-hundred miles off the Alaskan Coast in the central Bering Sea, foreign fishers aggressively trawl for pollock and other bottom dwelling fish. See Jeffreys, *supra* note 8, at 319.

82. See PETER WEBER, WORLDWATCH PAPER NO. 116, ABANDONED SEAS: REVERSING THE DECLINE OF THE OCEANS 14 (1993); Jeffreys, *supra* note 8, at 318.

83. Agenda 21 of the 1992 Rio Declaration on Environment and

protect straddling fish stocks,⁸⁴ which cross over from their EEZ into an adjacent area.⁸⁵ Coastal nations can do this by seeking, "either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary for the conservation of these stocks in the adjacent area,"⁸⁶ and are thus required under international law to agree upon such conservation measures.⁸⁷ As such, it is now possible to create incentives for pri-

Development specifically addressed high seas fisheries and called for the convening of a United Nations conference to promote "effective implementation of the provisions of the United Nations Convention on the Law of the Sea on straddling fish stocks and highly migratory fish stocks.", *Report of the United Nations Conference on Environment and Development*, U.N. Conference on Environment and Development, Annex II, § 2, ch. 17.49(e), Agenda Item 21, at 145-46, U.N. Doc. A/CONF.151/26 (1992).

84. The majority of the world's fisheries exist within 200 miles of the coast, but straddling fish stocks do not stay completely within that zone. See KENNETH A. DAHLBERG ET AL., ENVIRONMENT AND THE GLOBAL ARENA 93 (1985).

85. UNCLOS recognized the right of coastal states to manage fishing of anadromous, highly migratory fish (like salmon), even on the high seas. See UNCLOS, *supra* note 4, art. 64.

86. UNCLOS, *supra* note 4, art. 63(2). Furthermore, coastal states have the right to determine what constitutes "allowable catch." *Id.* art. 119. Article 119 of UNCLOS adopts the FAO definition of "allowable catch," which states "that catch which, if taken in any one year will best enable the objectives of [fisheries] management (e.g. the optimum long-term yield [of fish stock] to be achieved." Setting the standard of allowable catch requires consideration of biological, ecological, social, and economic interests. *Id.* Biological and ecological interests include taking into consideration a view "to maintaining or restoring populations" of harvested species "above levels at which their reproduction may become seriously threatened." *Id.* art. 119(1)(b).

Enforcement provisions of the Convention allow coastal states the right to board vessels, make physical inspections, and institute proceedings including the detention of the vessel where there are "clear grounds for believing that a vessel navigating in the exclusive economic zone . . . committed a violation of applicable international rules and standards for the prevention, reduction and control of pollution from vessels. . . ." *Id.* art. 220(3); see also Mark Christopherson, *Toward A Rational Harvest: The United Nations Agreement On Straddling Fish Stocks And Highly Migratory Species*, 5 MINN. J. GLOBAL TRADE 357, 371 (1996).

87. See UNCLOS, *supra* note 4, art. 63(2). Article 87 of the UN-

vate industries to cultivate coastal fisheries.

VI. PRIVATE PROPERTY RIGHTS IN THE OCEAN

Most ocean life (especially that which is subject to human harvest) is found above or near the continental shelf regions that ring most land masses.⁸⁸ With the Public Trust defining the coastal boundary and the EEZ defining the outer boundary,⁸⁹ the vast majority of productive ocean waters are subject to regulation, which can and should include private property interests.⁹⁰

The concept of property rights in public waters is not new.⁹¹ Several states already permit private development of oyster beds off their coasts, and the results are instructive. Washington State, for instance, recognizes private property rights down to the low tide mark. Consequently, in some areas, several hundred feet of tidal mud flats can be privately owned.⁹² Whereas public oyster

CLOS also requires due regard for the rights of coastal states. *See id.* art. 87(2).

88. *See* Jeffreys, *supra* note 8, at 299.

89. In his Keynote Address to this symposium, Paul C. Pritchard discussed the need for public/private ventures to protect the environment. The Public Trust Doctrine is the original joint venture of this type. *See* Pritchard, *Our National Parks: Assumptions, Metaphors, and Policy Implications*, 8 *FORDHAM ENVTL. LJ.* 421 (1997):

90. "Private stewardship of environmental resources is a powerful means of ensuring sustainability." Fred L. Smith, *Private Industry is Good for the Environment*, in *OPPOSING VIEWPOINTS*, *supra* note 3, at 134, 136. "Simply demarcating international boundaries within the ocean is insufficient if a property rights treatment is lacking within those boundaries." Jeffreys, *supra* note 8, at 313. That is why ITQs must also be used.

91. The concept of private interests protecting the environment is often controversial. Many people would prefer to leave it to public actors. As Professor Mary Doyle explained at the symposium, however, governmental decision makers have not always done well for the environment. Mary Doyle, Remarks on the Florida Everglades Restoration Project at the *Fordham Environmental Law Journal Symposium on Recent Developments in Natural Resources Law & Policy* (Feb. 11, 1997). Many of today's public projects are aimed at undoing what the government did in the past. *See also* Fred L. Smith, *supra* note 90, at 138 (stating governments subject to special interests).

92. *See* Jeffreys, *supra* note 8, at 332 n.25.

beds in many areas have been in serious decline for years,⁹³ the private beds in Washington state are thriving.⁹⁴

Fee simple ownership of the oyster beds makes the owners behave more like farmers than fishermen and causes them to be "staunch defenders of water quality."⁹⁵ In Washington, managers of terrestrial pollution sources agreed, in at least one case, to eliminate sewage discharges due to the threat of legal action by the oyster bed owners.⁹⁶ In fact, "local interests ranging from attorneys to environmentalists concede that the healthy, pristine nature of Willapa Bay is largely due to the efforts of the oyster growers, motivated by the desire to protect their source of livelihood."⁹⁷

Similarly, the lobster industry along the coast of Maine has developed an effective system of private property rights manage-

93. See De Alessi, *Fish Policy Failure*, *supra* note 5, at 3 (noting the decline of the oyster beds on the Chesapeake, just outside Washington D.C.).

94. See *Oyster Stewardship*, CEI UPDATE (Competitive Enterprise Inst.), Mar. 1996, at 7.

95. *Id.* In the 1940s and 50s, oyster growers successfully opposed pulp mill pollution, but they still have problems with nonpoint source pollution, predators, and weeds. See *id.*

96. See Jeffreys, *supra* note 8, at 303; Michael De Alessi, *Oysters and Willapa Bay* (Center for Private Conservation, March 1996) at 5 <<http://www.cei.org:80/essays/alessi1.html>>. Professor Peter Manus explained at the symposium that it is often hard to sue for pollution damage to fish, but a property rights approach makes that easier to do. Peter Manus, Address on "Natural Resource Damages under CERCLA" at *Fordham Environmental Law Journal* Symposium on Recent Developments in Natural Resources Law & Policy (Feb. 11, 1997).

97. See De Alessi, *Fish Policy Failure*, *supra* note 5, at 3 (explaining how a "commons" view almost destroyed oyster production, until privatization and cultivation of new beds restored the crop). While many environmentalists are suspect of business decisions relating to the environment, Mary Doyle's presentation to this symposium made it clear that governmental decisions have not always ended up being good for the environment. See Doyle, *supra* note 91. Paul Pritchard's keynote address brought up the possibility of introducing market concepts to limit the number of visitors to national/parks and reduce the resultant damage. See Paul C. Pritchard, Address at the *Fordham Environmental Law Journal* Symposium on Recent Developments in Natural Resources Law & Policy (Feb. 11, 1997).

ment, and the catch has been stable for decades.⁹⁸ Individual lobster fishermen strategically place their traps or pots within their area. They then jealously guard the quality of the environment, as well as their traps.⁹⁹

In England, the common law permits a riparian owner to enjoy "the water flowing past his land in its natural state of purity, and every fishery owner is entitled to the free movement of fish up and down a river from the sea to the source."¹⁰⁰ Because of this, an English riverbank owner can sue polluters under the common law actions of trespassing and nuisance.¹⁰¹ This legal structure permits private fishing clubs to bring civil suits against polluters. Such suits began in earnest in 1948, and over the past 20 years, approximately 2,000 such suits have been filed, with a high rate of success.¹⁰² These fishing clubs were "fighting pollution twenty years before the public and politicians became aware of the threat from water pollution."¹⁰³

English riparian owners have the right to limit access to the water on their property. Accordingly, fishermen must privately contract with land owners to obtain the right to fish in those waters. This market-driven structure has resulted in British landowners hiring "river keepers" to manage their fishery resources.¹⁰⁴ Similarly, farmers in Denmark who own property adjacent to the coastline have an ancient right to lay eel traps.¹⁰⁵

98. See Jeffreys, *supra* note 8, at 321.

99. See *id.* at 321.

100. Jeffreys, *supra* note 8, at 303-304.

101. See *id.* at 303. For a discussion of the advantages of common law actions to enforce environmental concerns, see Ronald J. Rychlak, *Common Law Remedies for Environmental Wrongs: The Role of Private Nuisance*, 59 MISS. L.J. 657 (1989).

102. See Bruce Yandle, *Matching the Problem to Each Level of Government*, VITAL SPEECHES, Oct. 1, 1995, at 754, available in 1995 WL 12606441 (nuisance suits in England).

103. Jeffreys, *supra* note 8, at 304.

104. See *id.* at 304; see also David Voreacos, *Making Waves: Group Fights Water Pollution*, THE RECORD, Nov. 29, 1993, at A3 (reporting river keepers in the United States).

105. See Jeffreys, *supra* note 8, at 304; see also Robert J. Smith, *Resolving the Tragedy of the Commons by Creating Private Property Rights in Wildlife*, CEI <<http://www.cei.org:80/essays/smith1/.html>> (discussing

This enables them to control access and secure rents from those who wish to lay their own traps. In both nations, there is an important economic incentive to protect the marine animals.

In Japan, tracts of sea and the resources they contain belong to individual fishermen, and Japanese fisheries have a legal status equal to that of land ownership.¹⁰⁶ Because of this, when developments are proposed on the coast, the developers must negotiate with the owner of the water resources.¹⁰⁷ If necessary, the developer must purchase any or all of the fishing rights that would be destroyed or diminished as a result of the development.¹⁰⁸ In fact, if development leads to the pollution of the fishing areas, the holder of the water rights has standing to sue the land developer for damages, and many such suits have been successful.¹⁰⁹

There is no reason why, at least in principle, this private property concept might not be applied to American coastal waters. When water-based resources are privately owned, the owners can establish legal precedents to deter future resource abuse. That way, "vital ecological habitat can be protected by the same legal mechanisms that enable shopkeepers and homeowners to prevent trespass or property damage."¹¹⁰ Importantly, this resolves the tragedy of the commons: with a property rights system in place, shortages will lead to higher prices, which will provide the incentive to produce more fish through aquaculture and other stock enhancement methods.¹¹¹

VII. BUSINESS DECISIONS

It might take a while for aquaculturists to develop techniques that will be successful in coastal areas.¹¹² It will also take time to

private salmon fisheries).

106. See Jeffreys, *supra* note 8, at 316.

107. In both England and Japan, property rights relate to the fishery, not the ocean itself. See *id.* at 335 n.90.

108. See *id.* at 317.

109. See *id.*

110. *Id.* at 303.

111. For the classic treatment of this problem, see generally Ronald G. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

112. It may take some experimentation to identify the proper means of raising different species of fish. For instance, the Tilapia fish

learn how best to raise ocean fish, as people often know little "about life cycles, feeding and migratory habits, or possible interaction with other species."¹¹³ Some of the problems coastal aquaculturists will face include pollution,¹¹⁴ floods or shifts in normal ocean currents, predator fish, fish ranging beyond the harvesting area, and fluctuation in populations.¹¹⁵ Higher population densities have led to increased recreational use of the water, boating, and nutrient loading of the surrounding sea.¹¹⁶ Sport

did not do well in the early 1980s when improper aquaculture methods deprived it of much of its productivity. See Dennis Avery, *Saving the Planet with Pesticides: Increasing Food Supplies While Preserving the Earth's Biodiversity*, in TRUE STATE, *supra* note 3, at 49, 64-65. By the 1990s the Tilapia was producing much better and had developed as a major aquaculture resource. The Tilapia now can thrive in intensive fish ponds and even flooded rice patties. See *id.*

113. See Jeffreys, *supra* note 8, at 299.

114. Nonpoint source pollution, which continues to be a difficult problem, may actually receive more attention in coastal areas than elsewhere. The 1990 amendments to the Coastal Zone Management Act require coastal states to develop plans to reduce and eliminate nonpoint sources of marine pollution. See *id.* at 302; see also Ronald J. Rychlak, *Coastal Zone Management and the Search for Integration*, 40 DEPAUL L. REV. 981 (1991). It should be noted that at the Symposium, Martha Noble indicated that the future of the Coastal Zone Management Act is in jeopardy. Martha Noble, Address at the *Fordham Environmental Law Journal* Symposium on Recent Developments in Natural Resource Law & Policy (Feb. 11, 1997).

115. One concern which may pose a greater concern to the general public will be the introduction of exotic species into a new ecosystem. See generally Stephanie Flack & Elaine Furlow, *America's Least Wanted*, NATURE CONSERVANCY, Nov./Dec. 1996, at 17-23 (discussing the invasion of non-native species, including the Flathead Catfish which was introduced for sport fishing, see *id.* at 18, and the damage they have caused). Of course, almost anyone from the southern United States could tell you about Kudzu, a non-native plant introduced to stop erosion, but which grew so wildly in the warmer climate that it threatened to choke off other species.

116. One answer to this is a multiple use plan. Most of the Great Barrier Reef along the Northeast Coast of Australia is included in the Great Barrier Reef Marine Park, a multiple use arrangement with separate zones for activities such as fishing, research, tourism, and shipping. See Jeffreys, *supra* note 8, at 325.

fishers, unless accommodated,¹¹⁷ are likely to be “a potential political and economical force as well.”¹¹⁸ All of these matters would suggest that aquaculture operations might have difficulty thriving near high population areas.¹¹⁹ Factors such as these would have to be evaluated before a project is undertaken, but, if the free market is given a chance, it comes down to simple business judgement. Decisions such as these are made in all lines of business everyday.

One potentially adverse affect of further reliance on ITQs is that it will tend to concentrate power in those larger operations that can afford them.¹²⁰ Those aquaculturists who are ineffective will, in all likelihood, be bought out by others who have been more accurate in their forecast. This is the same situation being faced across America, in farming and in retail. Certain market abuses will become possible, but this is a simple cost that comes with greater efficiency.

CONCLUSION

Currently, while there are certain community, state, and federal initiatives to help develop breeding grounds for fish, incentives for private development are “virtually nonexistent.”¹²¹ “[N]o

117. Of course, this tension already exists. “[M]any commercial fisheries would benefit from the establishment of reserves where all fishing was prohibited. Ideally, these should be established around known breeding grounds and other habitats vital to the perpetuation and proliferation of target species.” *Id.* at 329.

118. *See id.* at 298. “Recreational fishermen and organizations have been able to close many commercial fisheries through political actions.” *Id.* at 313. Depending on how technology develops, it may even be that aquaculture harvesting could relate to bottom dwelling fish, while sports fishing would be permitted closer to the surface.

119. “[A]rtificial reefs may offer the potential to expand stocks of reef fish.” *Id.* at 323. They have already been used to improve fishing prospects for more than one hundred years. *See id.* The preliminary research indicates that the organisms that attach themselves to the artificial reef are not simply transplanted from other reefs, but reflect a net increase in marine biomass because the new reef provides habitat without which these other organisms would die. *See id.* at 337, n.129.

120. *See* Tipton, *supra* note 7, at 399, 406.

121. *See* Jeffreys, *supra* note 8, 324.

one has any incentive to bolster the supply side; everyone has an incentive to deplete."¹²² If those who develop local fisheries' resources could reap the private benefits of their efforts, while at same time protecting the public trust, the result would be an increase in both bio-diversity and total fish populations.

By using the Public Trust Doctrine to encourage coastal aquaculture, it should be possible to obtain most of the benefits of private development without the restrictions that come with outright private ownership. Private entrepreneurs might even be able to help bring back species threatened with extinction.¹²³ We have only begun to realize the tremendous potential that the oceans hold for humans. Technology is now making possible what was once no more than a dream. It is now time for aggressive action from the coastal states to spur private industry to new levels of productivity. This can be accomplished without threatening precious water resources. In fact, this approach should help restore those resources which have been badly abused under our current legal scheme.

122. *Id.* at 319.

123. For instance, the Green Sea Turtle, like all sea turtles, is threatened by a combination of fishing pressures and the loss of coastal ground in which to lay eggs. *See* Robert J. Smith, *supra* note 105. A group of entrepreneurs, joined together in the Cayman Islands, however, for the purpose of breeding and marketing these turtles. Before long, they had built a population of almost 80,000 captive turtles and were returning yearlings to areas of depleted wild populations. Unfortunately, the project received an essentially fatal blow when it was denied an exception from the U.S. Fish and Wildlife Service ban on trade in sea turtle products. With the economic incentive to produce sea turtle products limited to small local markets, the project lost any chance for long-term viability. *See* Jeffreys, *supra* note 8, at 308-09. Nevertheless, the initial success and the entrepreneurs' willingness to reintroduce the animals into the wild indicate the real possibilities that exist for projects such as this in the future.

