

CHAPTER 22:**SETTING A COURSE FOR SUSTAINABLE MARINE AQUACULTURE**

As world consumption of seafood continues to increase, the farming of marine species has become a rapidly growing domestic and international industry. There are, however, a number of challenges that this industry presents. Nearshore marine aquaculture activities are affected by increasing population and development pressures and confusing or overlapping laws, regulations, and jurisdictions. Aquaculture operations in offshore waters lack a clear regulatory regime, and questions about exclusive access have created an environment of uncertainty that is detrimental to investment in this industry. Also of concern are potential threats to the environment and to native fish populations, and conflicts between aquaculture and other uses of the nation's ocean and coastal waters. A lead federal agency with an office dedicated to marine aquaculture is needed to address jurisdictional issues and to ensure the development of an economically and environmentally sound marine aquaculture industry.

ACKNOWLEDGING THE GROWING SIGNIFICANCE OF MARINE AQUACULTURE

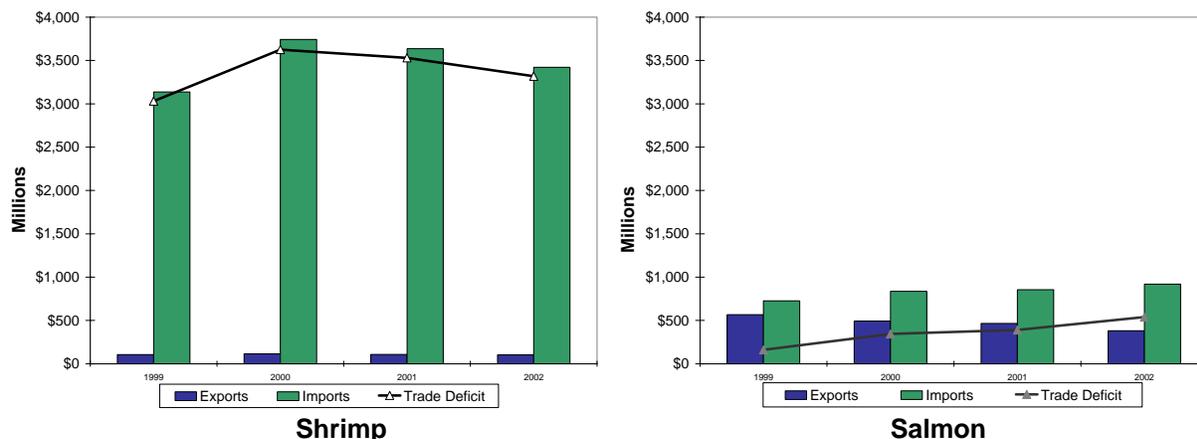
As traditional harvest fisheries have approached and exceeded sustainable levels, the farming of fish, shellfish, and aquatic plants in marine and fresh waters has become a burgeoning global industry. These animals can be raised in everything from nearly natural environments to enclosed structures, such as ponds, cages, and tanks, where they are fed and treated to maximize their growth rate.

In the United States, the demand for seafood continues to grow as expanding numbers of Americans seek healthier diets. During the 1980s and 1990s, the value of U.S. aquaculture production rose by about 400 percent, to almost \$1 billion. This figure includes freshwater and marine finfish and shellfish, baitfish, and ornamental fish for sale to aquariums.¹ Along with fish farmers themselves, the aquaculture industry supports an infrastructure of feed mills, processing plants, and equipment manufacturers. There is great potential for marine aquaculture to become an even more important source of seafood for the U.S. market and a way to help reduce the nation's seafood trade deficit of \$7 billion a year (Figure 22.1).²

ADDRESSING ENVIRONMENTAL IMPACTS OF AQUACULTURE

National management of marine aquaculture activities should minimize potential environmental impacts. These impacts include the spread of disease among fish populations, genetic contamination and competition between farmed and native stocks, and effects from aquaculture operations on water quality, wetlands, and other natural habitats. Fish waste, dead fish, uneaten food, and the antibiotics and hormones used to promote growth in captivity may contaminate the water around aquaculture facilities and harm surrounding ecosystems. Marine mammals, attracted by the food source, can become entangled in nets. There are also concerns about the increased demand for fishmeal used to feed farm-raised carnivorous fish. Obtaining fishmeal from traditional wild harvest practices may increase the pressure on fisheries that are already fully exploited. Extensive research is underway by the aquaculture community to determine how to decrease this demand.

Figure 22.1. The United States Imports More Seafood than it Exports



The dollar values of U.S. imports and exports for both shrimp and salmon illustrate the trade deficits caused by the nation's inability to harvest or culture enough seafood to meet consumer demand. Increasing aquaculture activities could help to reduce the nation's dependence on foreign seafood.

Source: U.S. Department of Agriculture, Economic Research Service. *Aquaculture Outlook 2003*. LDP-AQS-17. Washington, DC, March 14, 2003.

Another issue of increasing concern is the possible introduction of non-native species (intentionally or unintentionally) through marine aquaculture operations. In the United States, many cultured marine species are not native to the area where they are being farmed. In these cases, there is the possibility that foreign or genetically-modified species, or their reproductive offspring, may escape and potentially compete or reproduce with wild populations, resulting in unpredictable changes to ecological, biological, and behavioral characteristics. Where non-native species come in contact with already depleted fish or shellfish stocks, recovery efforts may be hampered.

Potential problems associated with the introduction of non-native species are illustrated in the case of the Atlantic salmon, which is one of the most widely farmed fish species in the United States and around the world. Escaped farm-bred salmon, which differ genetically from species of wild Atlantic salmon, have the potential to both compete with native salmon species (at least one of which has been listed as threatened or endangered under the Endangered Species Act) for limited resources, interbreed with native species causing changes in the gene pool, and spread disease. Infectious salmon anemia and sea lice, which are widespread in European salmon aquaculture facilities, have recently appeared in North American operations.³

Another example, discussed in more detail in Chapter 17, is the proposed farming of a non-native oyster species from China in Chesapeake Bay tributaries. This Chinese oyster appears to be resistant to the diseases plaguing the native species. However, a 2003 National Research Council report raised serious questions about the possible ramifications of such an introduction.⁴ It is now up to state officials to decide what is best for the Bay, in both the short- and long-term, with little science or law to guide them.⁵ Ironically, the steep decline in the Bay's native oyster population was caused in part by a disease introduced in the 1950s during a previous attempt to establish a non-native oyster species.

DEALING WITH UNCERTAINTIES IN THE EXISTING MANAGEMENT STRUCTURE

The potential contribution of marine aquaculture to the nation's economic growth and to meeting the increasing demand for seafood is impeded by its current management framework, which is characterized by complex, inconsistent, and overlapping policy and regulatory regimes administered by numerous state and federal agencies.

Federal Involvement

Federal agencies directly or indirectly involved in regulating marine aquaculture include the U.S. Departments of Agriculture and the Interior, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard, and the U.S. Environmental Protection Agency (EPA). The responsibilities of these agencies range from protecting water quality and other environmental issues, to navigation, to food safety concerns, to interactions with federal fishery management plans. The jumble of authorities makes it difficult for those involved in aquaculture activities to know what permits are needed and to be able to comply with all of the relevant rules governing their operations.

Because nearly all marine aquaculture activities operating today are located in nearshore waters under state jurisdiction, the majority of laws and regulations that authorize, permit, or control these activities are found at the state level and are not designed to address offshore aquaculture activities in federal waters.

Marine Aquaculture in Offshore Areas

As competition for space in nearshore areas intensifies, the marine aquaculture industry is looking increasingly toward opportunities in federal offshore waters. The nation's first commercial open ocean aquaculture operation began in 2001, when ownership of a public project in Hawaiian waters was transferred to a private firm. Other offshore aquaculture activities—most of which are in the pilot project stage—include the operation of a net pen adjacent to an oil platform in the Gulf of Mexico, and federally sponsored experiments off the coasts of Massachusetts and Hawaii.

The expansion of aquaculture activities into offshore waters provides potential benefits as well as additional concerns. Locating marine aquaculture activities farther offshore may reduce the visibility of these activities from land, be less intrusive to fisheries and recreational activities, and have fewer environmental impacts than activities located in nearshore areas. However, the logistics associated with operating offshore facilities are also more difficult, requiring long transit times for workers and supplies and other technical complications. Offshore aquaculture structures must also be designed to withstand the effects of extreme winds, waves, and temperatures, and be positioned in a way that does not create a hazard to navigation.

The Current Regulatory Conundrum

The Outer Continental Shelf Lands Act confirmed federal jurisdiction over non-living resources beyond three nautical miles from shore and authorized the Secretary of the Interior to create a legal regime—including leasing rights, fees, and revenue-sharing requirements—for oil, gas, sulfur, and other mineral resources. The Act, however, does not cover other commercial activities in federal waters, such as aquaculture. The Coastal Zone Management Act grants states the right—under prescribed circumstances—to review and raise objections to federally permitted activities beyond state waters, but the Secretary of Commerce may override the state's objection. Moreover, as described above, numerous federal agencies are directly or indirectly involved in implementing laws associated with various aspects of offshore activities, including marine aquaculture.

In 1980, Congress passed the National Aquaculture Act stating that it is in the national interest to encourage the development of aquaculture in the United States and calling for a national aquaculture development plan. The Act required the Secretaries of Agriculture, Commerce, and the Interior to prepare a report on federal laws and regulations that restrict the development of commercial aquaculture operations and submit the report to Congress with recommendations on how to remove unnecessarily burdensome regulatory barriers. However, no comprehensive and streamlined regulatory regime has been developed.

This does not mean that no regulatory requirements exist for offshore aquaculture: prospective operators of an aquaculture facility on the outer Continental Shelf (OCS) can apply to USACE for a permit pursuant to Section 10 of the Rivers and Harbors Act; EPA has authority pursuant to the Clean Water Act to regulate

effluent and other discharges from most aquaculture facilities on the OCS; the National Marine Fisheries Service and the U.S. Fish and Wildlife Service have authority to regulate offshore aquaculture facilities with respect to activities involving the Marine Mammal Protection Act and the Endangered Species Act; the Coast Guard has authority to require lights and signals and establish a safety zone to protect the facility and other users of the offshore waters; and coastal states may have and exercise “federal consistency” authority pursuant to the Coastal Zone Management Act.

Another potential legal impediment, which increases the legal and economic risk for offshore aquaculture, is NOAA’s assertion, through an agency legal opinion, that aquaculture facilities in the exclusive economic zone are subject to the Magnuson-Stevens Fishery Conservation and Management Act if the aquaculture operation uses any harvesting or support vessel. While the Magnuson-Stevens Act may not have been intended as a vehicle for managing marine aquaculture, such assertion of authority by NOAA contributes to an already muddled management regime.

As a result of this inconsistent mix of laws and regulations, applicants have no guarantee of exclusive use of space in offshore areas, private capital is difficult to obtain, insurance companies do not provide coverage, and banks are unwilling to accept the unknown risks involved. Enhanced predictability is needed, as is the elimination of unnecessary hurdles and the reduction of potential conflicts with other commercial and recreational users of offshore areas and resources. (More information about developing a framework for managing multiple activities in federal waters, including aquaculture, is found in Chapter 6.)

DEVELOPING A NEW MARINE AQUACULTURE MANAGEMENT FRAMEWORK

For the marine aquaculture industry to reach its full potential, the United States should develop a coordinated and consistent policy, regulatory, and management framework. Federal and state agencies, with full participation by the industry, will need to implement the new framework, and the academic community will be called upon to provide scientific and engineering support to ensure that marine aquaculture activities are ecologically and economically sustainable. This framework must be flexible and responsive to changes in the industry. Finally, development of a national aquaculture management framework must be considered within the context of overall ocean policy development, taking into account other traditional, existing, and proposed uses of the nation’s ocean resources.

Coordinated Action

The inherent differences between land-based, closed-system aquaculture operations and marine-based operations should be acknowledged in any new legislation and in the new management framework. The respective roles of the federal agencies involved with the marine aquaculture industry must also be clarified, duplicative or outdated laws and regulations eliminated, and marine aquaculture policies, programs, and practices coordinated. In addition, a lead federal agency is needed to act as the main interface with industry and overseer of the government’s public trust responsibilities.

The National Aquaculture Act of 1980 established the Joint Subcommittee on Aquaculture (JSA) within the National Science and Technology Council (NSTC) structure. The JSA coordinates federal agency activities, ensures communication among the agencies, and provides recommendations for national aquaculture policy. Members of the JSA include: the Secretaries of the Departments of Agriculture (permanent chair), Commerce, the Interior, Energy, and Health and Human Services; the Administrators of the Environmental Protection Agency, the Small Business Administration and the U.S. Agency for International Development; the Chair of the Tennessee Valley Authority; and the Director of the National Science Foundation. This kind of coordination is very much needed, although the issues to be addressed go far beyond the purview of the NSTC. Close coordination will be needed between JSA and the National Ocean Council.

Recommendation 22–1. Congress should amend the National Aquaculture Act to designate the National Oceanic and Atmospheric Administration (NOAA) as the lead federal agency for

implementing a national policy for environmentally and economically sustainable marine aquaculture and create an Office of Sustainable Marine Aquaculture in NOAA.

Implementation

In overseeing marine aquaculture activities, including evaluating and approving offshore aquaculture operations, NOAA will need to practice wise stewardship of ocean resources and weigh the needs of a variety of stakeholders. At the same time, offshore aquaculture operators will need assurance that they can have exclusive access to certain waters for specific periods of time to secure financial investments.

These goals can best be achieved through the development and implementation of a leasing system for the water column and ocean bottom that protects marine resources and environments, offers adequate exclusivity to aquaculture operations, and institutes a system of revenue collection that acknowledge the public interest in ocean space and resources. The leasing system will also need to specify details, such as applicant eligibility and the acceptable scope, size, duration, and degree of exclusivity for facilities. Competing uses of ocean and coastal areas, and the potential for impacts from aquaculture on other ocean uses, must also be considered. A comprehensive leasing system will also reduce duplicative information collection by different agencies, and facilitate coordinated federal responses.

Enhanced coordination is also needed between federal and state aquaculture policies and regulations to provide consistency to the industry and to adequately manage potential impacts that cross jurisdictional lines, such as the spread of disease. Significant state participation and input is needed in the development and implementation of a new national management framework, which should include guidelines and regulations that are complementary at the federal and state levels.

Recommendation 22–2. The National Oceanic and Atmospheric Administration’s new Office of Sustainable Marine Aquaculture should be responsible for developing a comprehensive, environmentally-sound permitting, leasing, and regulatory program for marine aquaculture.

The permitting and leasing system and implementing regulations should:

- *reflect a balance between economic and environmental objectives consistent with national and regional goals.*
- *be coordinated with guidelines and regulations developed at the state level.*
- *include a system for the assessment and collection of a reasonable portion of the resource rent generated from marine aquaculture projects that use ocean resources held in public trust.*
- *include the development of a single, multi-agency permit application for proposed marine aquaculture operations.*
- *include a permit review process that includes public notice and an opportunity for state, local and public comment.*
- *require applicants to post a bond to ensure that any later performance problems will be remedied and that abandoned facilities will be safely removed at no additional cost to the taxpayers.*
- *require the development, dissemination, and adoption by industry of best management practices that are adaptable to new research and technology advances.*
- *be well coordinated with other activities in federal waters, as described in Chapter 6.*

INCREASING THE KNOWLEDGE BASE

Enhanced investments in research, demonstration projects, and technical assistance can speed the development of a responsible and sustainable marine aquaculture industry. Science-based information can help the industry address environmental issues, conduct risk assessments, develop technology, select species, and improve best management practices. It is also vital for developing fair and reasonable policies, regulations, and management measures.

In the last two decades, the number of research and monitoring programs related to aquaculture has surged. Much of the work conducted worldwide has focused on the effects of open-water, net-pen culture on the environment. In the United States, early research efforts focused on fish hatchery effluents and catfish ponds.

As the domestic industry has diversified, so has the scope of research efforts, with major federal investments to examine the impacts of marine shrimp-pond and salmon net-pen cultures, as well as issues concerning aquaculture feeds, species introductions, the use of chemicals and pharmaceuticals, and effluent controls.

Most of the federal research to support marine aquaculture has been carried out under the auspices of NOAA's National Sea Grant College Program, which funds primarily university-based research. Results are used by educators and outreach specialists to improve resource management and address development and conservation issues. Sea Grant-funded information is also used to increase the knowledge base of industry, government agencies, and the public.

Recommendation 22–3. Congress should increase funding for expanded marine aquaculture research, development, training, extension, and technology transfer programs in the National Oceanic and Atmospheric Administration. The Office of Sustainable Marine Aquaculture should set priorities for the research and technology programs, in close collaboration with academic, business, and other stakeholders.

PROMOTING INTERNATIONAL IMPROVEMENTS AND COOPERATION

An estimated one billion people worldwide rely on fish as their primary source of animal protein. This demand will continue to rise as human populations increase and wild stocks around the world are depleted. Aquaculture has been growing almost six times faster in developing countries than in developed countries. The United Nations Food and Agriculture Organization (FAO) estimates that by 2030 more than half of the fish consumed globally will be produced through aquaculture.⁶

While the majority of international aquaculture occurs in inland and coastal areas, interest in offshore operations is also growing. There are even proposals to establish aquaculture operations on the high seas (see Chapter 29 for a discussion of emerging international ocean-related management challenges). This new interest is accompanied by growing concerns about the potential environmental impacts of offshore operations. The use of non-native species for aquaculture also poses ecological risks, particularly in view of the absence of regulations and enforcement in many countries. Global policies on prevention, containment, monitoring and risk assessments are needed to prevent the spread of invasive species and ensure that industries operate sustainably.

Efforts are underway at FAO to assess the possible environmental implications of booming aquaculture operations around the world and to develop appropriate protocols for use by government and industry. In the meantime, FAO's non-binding Code of Conduct for Responsible Fisheries includes a number of aquaculture provisions. The Code calls for: appropriate assessments and monitoring to minimize adverse impacts from discharges of effluents, waste, drugs and chemicals; consultation with neighboring countries prior to the introduction of nonnative species; conservation of genetic diversity; and responsible choices of species, siting and management. These guidelines are excellent but their implementation will require much stronger national commitments.

Recommendation 22–4. The United States should work with the United Nations Food and Agriculture Organization to encourage and facilitate worldwide adherence to the aquaculture provisions of the Code of Conduct for Responsible Fisheries.

¹ U.S. Department of Agriculture, Economic Research Service. "Briefing Room: Aquaculture Overview." <<http://www.ers.usda.gov/briefing/aquaculture/overview.htm>> Accessed October 21, 2003.

² National Marine Fisheries Service. *Fisheries of the United States 2002*. Silver Spring, MD: National Oceanic and Atmospheric Administration, September 2003.

³ Goldberg, R.J., M.S. Elliot, and R.L. Naylor. *Marine Aquaculture in the United States: Environmental Impacts and Policy Options*. Arlington, VA: Pew Oceans Commission, 2001.

⁴ National Research Council. *Non-native Oysters in the Chesapeake Bay*. Washington, DC: National Academy Press, 2003.

⁵ Blankenship, K. "State, Federal Roles in Oyster Introduction Pondered." *Bay Journal* 13, no. 7 (October 2003).

⁶ Food and Agriculture Organization of the United Nations. *The State of the World Fisheries and Aquaculture*. Rome, Italy, 2000.