

# 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 organisms 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 fresh-water and marine finfish and shellfish, baitfish, and ornamental fish for sale to aquariums.<sup>1</sup> 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).<sup>2</sup>

Figure 22.1 The United States Imports More Seafood Than It Exports



The 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.

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

## 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 antibiotics 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.

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) animals 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.<sup>3</sup>

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 native species. However, a 2003 National Research Council report raised serious questions about the possible ramifications of such an introduction.<sup>4</sup> 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.<sup>5</sup> 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.

All of the potential impacts discussed in this section need to be addressed if the nation is to achieve an environmentally and economically sustainable marine aquaculture industry.

## 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.

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. For example, one of the first U.S. commercial open ocean aquaculture projects in Hawaii began in 2001 with the lease of 28 acres of state marine waters to a private company, following a 1999 state legislative authorization to allow commercial offshore aquaculture leasing. Other nearshore aquaculture activities—most of which are in the pilot project stage—include the operation of a federally-sponsored experiment off the coast of New Hampshire and a salmon facility off of Maine.

## 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 expansion of aquaculture activities into the outer Continental Shelf 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

There are numerous federal agencies directly or indirectly involved in implementing laws associated with various aspects of offshore activities, including marine aquaculture. These include the U.S. Departments of Agriculture and the Interior (USDA and DOI), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Food and Drug

Administration, 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 resources, to navigation, food safety concerns, and 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 what relevant rules govern their operations. (See Box 6.1 Swimming Through Hoops: Establishing an Offshore Aquaculture Facility.) Simply put, there is no overall ocean governance structure to comprehensively manage this new and emerging use in federal waters.

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 streamlined regulatory regime has been developed.

As a result of this 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.

## Developing a New Marine Aquaculture Management Framework

For the marine aquaculture industry to reach its full potential, the United States, in cooperation with states, tribes, and territories, should develop a coordinated and consistent policy, and a robust 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. It is important for this framework to be flexible and responsive to changes in the industry. Finally, as noted, 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. (More information about developing a framework for managing multiple activities in federal waters, including aquaculture, is found in Chapter 6.)

### 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 agen-

*The US aquaculture industry is developing in an unprecedented environmental and food safety climate. In many respects, this helps ensure the aquaculture industry is environmentally sustainable, while still providing needed rural employment and income.*

—Dr. Robert Rheault,  
Board Member, National  
Aquaculture Association,  
testimony to the  
Commission, June 2002

cies, and provides recommendations for national aquaculture policy. Members of the JSA include: the Secretaries of USDA (permanent chair), DOI, the Departments of Commerce, Energy, and Health and Human Services; the Administrators of EPA, 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 necessary, although the issues to be addressed go far beyond the purview of the NSTC. Close coordination will be needed between the 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 marine aquaculture, create an Office of Sustainable Marine Aquaculture in NOAA, and designate the Secretary of Commerce as a permanent co-chair, along with the Secretary of Agriculture, of the Joint Subcommittee on Aquaculture. NOAA should use this authority to design and implement national policies for environmentally and economically sustainable marine aquaculture.

### **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 ocean surface, 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 acknowledges 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.

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. The interstate fishery commissions could be a valuable resource to assist in coordinating federal and state activities.

### **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 rely on ocean resources held in the 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 or other financial guarantee to ensure that any later performance problems can be remedied and that abandoned facilities can be safely removed at no additional cost to taxpayers.
- require the development, dissemination, and adoption of best management practices, with periodic updates to reflect advances in research and technology.
- be well coordinated with other activities in federal waters.



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The SeaStation 3000 is an experimental aquaculture facility off the coast of Hawaii. The sea cage lies 40 feet below the surface to reduce the risk of harm to the cage or the fish from large ocean swells and is out of the way of local boating traffic. The project is the first of its kind in Hawaii and may serve as a model for future offshore aquaculture.

## Increasing the Knowledge Base

Enhanced investments in research, demonstration projects, and technical assistance can further the development of a responsible and sustainable marine aquaculture industry. Science-based information can help the industry address environmental issues, understand socioeconomic impacts to coastal communities, 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. Major federal investments are examining 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. As noted in Chapter 25, research on the potential socioeconomic impacts of marine aquaculture is sparse.

### Recommendation 22-3

The National Oceanic and Atmospheric Administration's new Office of Sustainable Marine Aquaculture should expand marine aquaculture research, development, training, extension, and technology transfer, including a socioeconomic component. The Office should set priorities for research and technology, in close collaboration with the National Sea Grant College Program, states, tribes, academia, industry, 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.<sup>6</sup>

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 growing 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 non-native species; conservation of genetic diversity; and responsible choices of species, siting, and management. The implementation of these guidelines will require strong commitments from the global community.

### 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.

## References

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