

Recommendations for an Operational Framework for Offshore Aquaculture in U.S. Federal Waters

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Foreword

This report details recommendations to implement governance changes critical to the development of sustainable marine aquaculture in federally-controlled offshore waters of the United States (generally 3-200 nautical miles offshore). Sustainable offshore aquaculture has the potential to enhance the availability of food resources for the public and to rebuild some fishery stocks.

Offshore aquaculture has come into the spotlight in the recent past due, in part, to findings in key reports such as the U.S. Commission on Ocean Policy, the Administration's Ocean Action Plan, and the Pew Oceans Commission. Recent developments such as the introduction of offshore aquaculture legislation in the U.S. Congress, the adoption of EPA's Effluent Limitation Guidelines for aquaculture facilities, and related work by fishery management councils have also generated added interest in offshore aquaculture. This policy study discusses options to correct gaps and deficiencies in the governance framework related to the siting, operation, and monitoring of offshore aquaculture facilities raising native species, with the question of management of non-native species set aside for future debate and analysis.

The report was prepared by an interdisciplinary, multi-institutional team (comprised of experts from a variety of disciplines and backgrounds: marine policy, law, industry, state government, environmental groups, and marine sciences) and included literature reviews, policy design, and consultation with stakeholders (state and local governments, private industry, and non-governmental organizations) through one national workshop and five regional workshops. The recommendations in this report reflect a consensus by the authors of the report, although no single author would agree with every recommendation in the study.

This report builds on a previous study carried out by a multidisciplinary and multi-institutional team coordinated through the Gerard J. Mangone Center for Marine Policy at the University of Delaware. That study, *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone*, was prepared by Biliana Cicin-Sain, Susan M. Bunsick, M. Richard DeVoe, Tim Eichenberg, John Ewart, Harlyn Halvorson, Robert W. Knecht, and Robert Rheault in 2001 as a technical report. Both of the studies were funded by grants from the National Oceanic and Atmospheric Administration (NOAA) and administered by the National Sea Grant College Program. This support is gratefully acknowledged.

Any errors or omissions in this report are solely the responsibility of the authors. This report reflects the collective work of the authors and does not reflect the opinions or position of NOAA.

The authors wish to express their sincere thanks to Jason Didden and to Meredith Blaydes for their collaboration in the organization of the research work and the editing of this volume, and to the following University of Delaware colleagues who provided support in various aspects of the project: Dr. Miriam Balgos, Kevin Goldstein, Shelby Hockenberry, Cathy Johnston, and Malinda Yarnell. The assistance of technical editor and graphic designer Jorge A. Gutierrez is acknowledged with sincere thanks.

Dr. Biliana Cicin-Sain
Project Director
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Executive Summary

REPORT HIGHLIGHTS

The report:

- Reviews the current status of marine aquaculture in the United States, the rationale for siting projects further offshore, and the results of the previous study in this series, which assessed federal policy with respect to the development of aquaculture as a relatively new ocean industry in federal waters. Relevant aspects of the U.S. Commission on Ocean Policy, President Bush's U.S. Ocean Action Plan, the Pew Oceans Commission, the National Offshore Aquaculture Act of 2005 (S. 1195, Stevens, Inouye), and the Environmental Protection Agency's Effluent Limitation Guidelines are also outlined (Chapter 1).
- Describes an administrative framework capable of executing recommended aquaculture policy changes made in this report (Chapter 2).
- Provides guiding principles and specific provisions of a system of offshore aquaculture leasing and permitting designed to increase predictability, efficiency, and accountability for offshore aquaculture development (Chapter 3).
- Details the necessary planning and site assessment actions to successfully site offshore aquaculture facilities, including the use of geographic information systems (GIS) and marine zoning (Chapter 4).
- Examines potential environmental ramifications of offshore aquaculture and steps to mitigate environmental effects (Chapter 5).
- Proposes a monitoring strategy to ensure that offshore aquaculture operations do not compromise environmental quality (Chapter 6).
- Presents guidelines and options for compliance with and enforcement of regulatory authority (Chapter 7).

RESEARCH RESULTS AND RECOMMENDATIONS

● ● ● *The Status and Challenges of Marine Aquaculture in the United States (Chapter 1)*

In 2002, total U.S. aquaculture (fresh and marine) production totaled 867 million pounds valued at \$866 million dollars. Harvest in weight increased about 10% from 1998 to 2002, although the value of the total harvest actually declined by about 8%, largely due to lower catfish prices and declines in both salmon harvest and salmon prices. Aquaculture products range from clams to baitfish to trout, with catfish usually accounting for about 70% of production by weight. In 2002, the major marine species used for aquaculture (salmon, oysters, clams, shrimp, and mussels) accounted for about 8% of

the total production by weight and about 18% by value.

Worldwide, one-fourth of all fish consumed is produced from aquaculture, and the United Nations (UN) Food and Agriculture Organization (FAO) predicts a widening gap between demand and available supply of seafood. With its expansive federal waters, the United States has the potential to supply large quantities of farmed seafood, and some pilot projects are testing different forms of offshore aquaculture. Conflict with other users of coastal areas will likely impede expansion of inshore aquaculture production, and offshore aquaculture is currently hindered by the lack of an appropriate governance framework for aquaculture in federal waters. Without a lead agency for offshore aquaculture, conflicts between regulatory agencies frequently oc-

cur, leading to confusion about environmental requirements, appropriate siting, permitting, and oversight and monitoring of offshore aquaculture facilities. Review of national and international experiences provides lessons for better governance of offshore aquaculture, which the 2001 study organized into guiding criteria and requirements for a successful policy framework.

The U.S. Commission on Ocean Policy (USCOP), the U.S. Ocean Action Plan, and the Pew Oceans Commission address marine aquaculture in their assessments of issues in and improvements to U.S. ocean policy. Also, the Administration submitted The National Offshore Aquaculture Act of 2005 on June 7, 2005 (S. 1195, Stevens, Inouye). Together, these four documents acknowledge the growth and promise of marine aquaculture and address relevant environmental and regulatory issues. The U.S. Commission on Ocean Policy advises the creation of an aquaculture office in the National Oceanic and Atmospheric Administration (NOAA) with explicit responsibility for management and coordination of offshore aquaculture. The U.S. Commission's recommendations center on facilitating and coordinating balanced development of marine aquaculture.

The President's U.S. Ocean Action Plan indicates that the Administration supports giving the Department of Commerce regulatory authority over offshore aquaculture and that the Administration supports EPA's authority to regulate effluents from aquaculture operations.

The Pew Oceans Commission recommends that a national oceans agency (recommended to be created) coordinate with regional ocean councils (recommended to be created) and the U.S. Environmental Protection Agency (EPA) to manage marine aquaculture. The Pew recommendations center on mitigating possible negative effects of marine aquaculture.

The National Offshore Aquaculture Act of 2005 (S. 1195 - Stevens, Inouye) gives the Secretary of Commerce the authority to implement a regulatory system for offshore aquaculture in Federal waters. Chapter 1 also outlines the provisions of EPA's 2004 Effluent Limitation Guidelines for concentrated aquatic animal production (CAPP) facilities.

A Proposed Administrative Framework (Chapter 2)

The authors posit that NOAA is the preferred option for the location of a lead program office for offshore aquaculture, because of its statutory authorities in federal waters as well as its expertise and organizational knowledge of marine science and public policy issues. The range of issues involved in offshore aquaculture warrants the creation of a new Office of Offshore Aquaculture within NOAA that would primarily plan for aquaculture development in federal waters and operate an aquaculture leasing system in federal waters through the rulemaking process. The office would initially need a minimum of 15-20 people, with long-term staffing needs dependent on the demand for leasing of sites. The office would need to coordinate with many entities including other NOAA offices, the Army Corps of Engineers, EPA, the Coast Guard, the U.S. Fish and Wildlife Service, the Food and Drug Administration, and the Minerals Management Service. The new office would negotiate Memoranda of Understanding/Agreement (MOUs/MOAs) or similar agreements with these agencies to establish the responsibilities, authority, and procedures involved in enforcing offshore aquaculture policy.

Chapter 2 Recommendations

Recommendation 2.1 The National Oceanic and Atmospheric Administration (NOAA) is the preferred option for the location of a lead program office for offshore aquaculture.

Recommendation 2.2 It is recommended that a new Office of Offshore Aquaculture (OOA) be created within NOAA. The NOAA Office of Offshore Aquaculture should report directly to the NOAA Administrator and be given the organizational authority to deal with inter-line office issues in implementing the offshore aquaculture program.

Recommendation 2.3 The NOAA Office of Offshore Aquaculture should consult and collaborate with the Joint Subcommittee on Aquaculture where appropriate, for example, regarding research priorities and regulatory review.

Recommendation 2.4 Federal agencies should negotiate Memoranda of Understanding/Agreement (MOUs/MOAs) or other agreements to set out the responsibilities, authorities, and procedures of all of the agencies involved in enforcing the offshore aquaculture provisions described in this document.



Leasing and Permitting (Chapter 3)

The present permitting framework translates into a loss of economic development potential of U.S. federal waters. This report recommends a streamlined, joint offshore aquaculture leasing and permitting process with a single application for a lease, a Section 10 Rivers And Harbors Act permit, a Section 402 discharge (NPDES/Clean Water Act) permit, and a Coastal Zone Management Act (CZMA) consistency determination. Project applications would need to include an Offshore Aquaculture Operational Business Plan that contained information on such factors as project location, engineering, operation, species, production schedule, environmental issues, monitoring, Best Management Practices (BMPs), and financial information.

A leasing framework should include stipulations on who is eligible to obtain a lease, the exact application requirements, spatial and temporal scope of the lease, exclusivity, compensation, provisions for state review and public input, provisions for monitoring of successful applicants, performance bonding, and termination procedures. Congress should create a new aquaculture leasing authority for NOAA, implemented by the proposed new NOAA Office of Offshore Aquaculture. Lease types would include research, short-term, long-term and emergency leases, for different project types and stages.

Chapter 3 Recommendations

Recommendation 3.1 It is proposed that leasing and permitting proceed jointly given the time and efficiency gains that are expected from joint leasing and permitting without any loss of environmental protection.

Recommendation 3.2 In light of the fact that joint leasing and permitting will require close coordination, the authors recommend that a formal mechanism be established to enable NOAA, the Army Corps of Engineers, and other interested federal agencies to cooperate with one another and to coordinate their respective reviews.

Recommendation 3.3 A joint, multi-purpose lease/permit application form to guide review by all appropriate federal and state agencies and the public, should be developed for use by all applicants seeking to lo-

cate aquaculture facilities in federal waters.

Recommendation 3.4 When applying for a standard offshore aquaculture lease and associated permits, the applicant should provide detailed information on the proposed aquaculture operation in the form of an Offshore Aquaculture Operational Business Plan.

Recommendation 3.5 Congress should create a new offshore aquaculture leasing authority, vest that authority with NOAA, and direct the Army Corps of Engineers to focus its Section 10 review on national security and navigation and to rely on the NOAA-coordinated environmental evaluation. Leases should spell out terms of tenure and operational parameters.

Recommendation 3.6 The NOAA Office of Offshore Aquaculture should have the authority to grant offshore aquaculture leases for areas in, on, and under federal waters and the responsibility to administer and monitor all offshore aquaculture leasing activities.

Recommendation 3.7 It is proposed that the NOAA Office of Offshore Aquaculture facilitate inter-agency interaction with other relevant permitting agencies, so as to create a one-stop process for applying for offshore aquaculture leases and permits.

Recommendation 3.8 Four types of leases should be authorized:

- (1) A **research lease** to encourage the development and testing of new gear or techniques and to allow for scientific research;
- (2) A **short-term (or interim) lease** to enable an aquaculture firm to further develop the facility's Offshore Aquaculture Operational Business Plan;
- (3) A **long-term (or standard) lease** for an applicant with a fully developed Offshore Aquaculture Operational Business Plan; and
- (4) An **emergency lease** to provide the culturist with a rapid response capability in the event facilities must be temporarily moved or relocated.

Recommendation 3.9 Consideration needs to be given to the cumulative impacts of offshore aquaculture facilities and, consequently, spacing and fallowing guidance should be developed by the NOAA Office of Offshore Aquaculture.

Recommendation 3.10 Adoption of a mechanism similar to the Request for Information and Interest (RFII), utilized by the Minerals Management Service in leasing sand and gravel resources, should be incorporated into the offshore aquaculture leasing program adopted by the NOAA Office of Offshore Aquaculture. The RFII process should be enhanced by requiring the scheduling of public hearings for areas potentially affected by the proposed offshore aquaculture operation.

Recommendation 3.11 In exchange for the semi-exclusive use of offshore space for aquaculture, the NOAA Office of Offshore Aquaculture should establish rental fee and royalty rates after due consultation with the offshore aquaculture industry, other ocean user constituencies, the public, and other federal agencies.

Recommendation 3.12 NOAA should coordinate reviews by agencies under other authorities such as the National Historic Preservation Act, the Endangered Species Act, the Marine Mammal Protection Act, the Fish and Wildlife Coordination Act, Magnuson-Stevens Fisheries Act, and the Coastal Zone Management Act.

Recommendation 3.13 Fishery Management Councils (FMCs) should review applications for potential impacts on essential fish habitat and impacts on fisheries under their purview; however, requirements such as restrictions on the total allowable catch, seasons and ownership that FMCs apply to capture fisheries should not be applicable to offshore aquaculture. Aquaculture operations conducted pursuant to a lease and all necessary permits should be excluded from the definition of “fishing” under the Magnuson-Stevens Act, 16 U.S.C. § 1802 (15).

Recommendation 3.14 It is critical for NOAA, the Army Corps, and EPA to involve states early in and throughout the zoning, leasing, and permitting processes, and states should receive timely and adequate notice as well as an opportunity to comment.



Planning and Site Assessment (Chapter 4)

Insufficient policy guidance is available for determining the best locations for offshore aquaculture. Poor siting can result in both economic and environmental inefficiencies. Planning for offshore aquaculture should begin with comprehensive delineation of the environ-

mental characteristics and traditional uses of offshore areas. From such a survey, agencies could identify candidate sites though further investigations of socioeconomic, physical, biological, and technical criteria. Siting procedures could include case-by-case site-specific leases, pre-permitted sites designated for marine aquaculture, pre-approved areas for short-term projects, or more comprehensive marine zoning including Marine Aquaculture Parks specifically designed to encourage development of marine aquaculture. Such marine zoning would fit into an overall management scheme for multiple-use management of federal waters. While our focus is on developing timely identification of sites suitable for offshore aquaculture, a more ideal model would provide for comprehensive planning of federal waters.

Chapter 4 Recommendations

Recommendation 4.1 It is recommended that comprehensive mapping of offshore areas be conducted to identify areas suitable for the offshore aquaculture industry as well as other uses and to further the development of a detailed, map-based marine zoning plan.

Recommendation 4.2 Two stages of public review, including the scheduling of public hearings for areas potentially affected by a proposed offshore aquaculture operation, are recommended for the planning process: upon commencement of the planning process and upon completion of the final plan.

Recommendation 4.3 A planning and management strategy for the location and siting of offshore aquaculture development should be a component of a comprehensive ocean and coastal management approach including consideration of socioeconomic and environmental criteria.

Recommendation 4.4 NOAA should consider the development of the following options for the placement of offshore aquaculture operations:

- **leases or easements granted on a case-by-case basis**, taking into account environmental criteria of the area and project-specific factors;
- identification of sites suitable for the designation of **pre-permitted sites for marine aquaculture**, upon securing necessary general permits to address state and federal regulatory requirements;
- **designated areas for short term leasing** of small scale or pilot projects in locations to minimize impacts on other user groups and on the environment;

- **zoned areas for multiple use**, depending upon the appropriateness of the site and public input;
- **marine aquaculture parks** to provide initial infrastructure, environmental assessment information, and designated areas for pilot, research, and longer-term commercial projects.

● ● ● **Environmental Review** (Chapter 5)

The environmental impacts of poorly planned or sited commercial-scale offshore aquaculture could include exceeding environmental carrying capacity, waste pollution of water and sediment, and potential genetic impacts, disease transmission, and competition from escaped organisms. Negative interactions with wild fisheries, marine mammals, birds, and endangered species could also occur. The precautionary approach should be used to minimize environmental effects and ensure development in a sustainable manner. Environmental review should be carried out during planning/assessment, leasing/permitting, and during long-term monitoring with adaptive management. Methods exist for mitigating many possible environmental effects of offshore aquaculture, and more research should be conducted on economically viable polyculture, a natural way of using multiple species to make an aquaculture operation a more balanced part of the surrounding ecosystem. Industry should assume responsibility for environmental degradation, costs for operational monitoring, and eventually a portion of the costs associated with baseline monitoring.

Chapter 5 Recommendations

Recommendation 5.1 Congress should clarify and confirm that NEPA applies to federal waters and the continental shelf.

Recommendation 5.2 Environmental impacts from aquaculture, such as those described in this chapter, should be avoided, minimized, or mitigated to the maximum extent possible.

Recommendation 5.3 A commitment to sustainability, application of the precautionary approach, concern for environmental carrying capacity, thorough scientific assessment and monitoring of the environment, ecosystem-based adaptive management, and public participation and transparency should

guide environmental review of aquaculture in federal waters.

Recommendation 5.4 Every environmental review should incorporate public (including stakeholders) review. Public input should be solicited and integrated into the process so that it can effectively influence decisions based on the environmental reviews.

Recommendation 5.5 Environmental review should be carried out at three stages of offshore aquaculture development and operation: planning/assessment, leasing/permitting, and long-term monitoring with adaptive management. The respective environmental reviews should be tailored to each stage of offshore aquaculture development and operation.

Recommendation 5.6 Initial environmental review and associated ecosystem monitoring should be done by or under the direction of the NOAA Office of Offshore Aquaculture, with costs shared (especially initially) by NOAA and the applicant. Costs of subsequent monitoring associated with comprehensive environmental review could also be shared while costs for routine operational monitoring should be borne by industry.

● ● ● **Monitoring (Chapter 6)**

The NOAA Office of Offshore Aquaculture should coordinate monitoring of offshore aquaculture facilities. Operators may be the best agents for some monitoring responsibilities. Federal agencies will likely need to gather baseline data given the limited scale of the current industry, sharing some costs with industry. Depending on the level of environmental concern related to a project, NOAA could require data on effluent loading, stocking, water column chemistry, phytoplankton composition, benthic community structure and function, sediment organic composition, disease incidence, and use of chemical therapeutics. NOAA would need to determine appropriate data needs and analytical techniques, along with a system that allows monitoring results to be incorporated into decision making. The most basic regimes would need to monitor or model for nutrients, dissolved oxygen, medicines and chemicals in the water or sediment, as appropriate.

Chapter 6 Recommendations

Recommendation 6.1 The NOAA Office of Offshore Aquaculture (OOA) should coordinate data collection efforts of state or federal agencies that regulate or assist the offshore aquaculture industry. The NOAA OOA should establish MOUs, MOAs, or other agreements with pertinent regulatory agencies to ensure that these data are supplied in a timely fashion and in a proper format to avoid duplication of effort.

Recommendation 6.2 A paramount objective of monitoring and regulation should be ensuring that offshore aquaculture activities do not exceed established environmental quality standards or the carrying capacity of the environment.



Compliance and Enforcement (Chapter 7)

Enforcement would be expected to center on environmental issues. Best Management Practices developed by industry, regulators and stakeholders should be used where possible, and adherence monitored by appropriate regulatory agencies. Assigning sufficient resources for monitoring and enforcement is critical. Criteria that give rise to enforcement actions, as well as violation penalties, need to be very clear and specific. Since environmental and operating conditions will change over time, some flexibility and adaptability are crucial for smooth governance of offshore aquaculture. Penalties could include fines, halting of activity, amending leasing agreements to correct deficiencies, remediation assignments, or in extreme cases, revocation of permits.

Chapter 7 Recommendations

Recommendation 7.1 The NOAA Office of Offshore Aquaculture should coordinate state and federal management initiatives and incorporate input from both public interests and the offshore aquaculture industry to ensure that no significant compliance and enforcement concerns are being overlooked, while at the same time avoiding unnecessary duplication of effort.

Recommendation 7.2 Offshore aquaculture operations should be guided by Codes of Conduct and Best Management Practices developed by industry,

regulators, and stakeholders. The appropriate regulatory agencies should monitor operations to ensure that the Codes and Practices are being followed.

Recommendation 7.3 It is imperative that the regulatory authorities be given adequate resources to monitor and enforce the offshore aquaculture industry.

Recommendation 7.4 Regulators must ensure that the operators understand well in advance the penalties associated with any violations and what regulatory actions will be taken if environmental impacts exceed established levels.

Recommendation 7.5 Monitoring results should be promptly reviewed by the appropriate regulatory authority for compliance with lease conditions as well as ecosystem impacts. The NOAA Office of Offshore Aquaculture should coordinate monitoring, data collection and enforcement activities by the various regulatory authorities.

Recommendation 7.6 Monitoring requirements and regulations should be flexible and adaptive so that they can respond to changes in operating procedures or environmental conditions. Frequent consultations between industry and regulatory authorities will minimize the monitoring burden and maximize the effectiveness of regulations.

Recommendation 7.7 Permit violations should be subject to civil and criminal penalties. If an operation causes damage to the ecosystem, then the operator should be held responsible for remediation and restoration, or, when such actions are not possible, reasonable costs of such damage.

CHAPTER

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OFFSHORE AQUACULTURE IN THE UNITED STATES: POTENTIAL AND OBSTACLES

MARINE AQUACULTURE IN THE UNITED STATES

This report addresses the potential for development of sustainable marine aquaculture in federally controlled offshore waters of the United States. These waters are hereafter referred to as “federal waters” and defined as those waters from the seaward (outside) limit of state jurisdiction to the seaward limit of federal jurisdiction, generally 3-200 nautical miles from the coast.* This area, although it includes a portion of the U.S. Territorial Sea, is sometimes referred to in U.S. law as the Exclusive Economic Zone (EEZ) (see EEZ definition in Magnuson-Stevens Fishery Conservation and Management Act, Public Law 94-265, 99-659 (11)). In this report, “marine aquaculture” refers to aquaculture in coastal or offshore areas. “Marine aquaculture” in “federal waters” is termed “offshore aquaculture.” This chapter describes the current state of marine aquaculture in the United States; summarizes a companion study on offshore aquaculture policy conducted in 2001 (on which this report builds); reviews several relevant new developments related to offshore aquaculture; and outlines the organization of this report.

The U.S. has not yet developed the necessary policy framework for siting, conducting, and monitoring offshore aquaculture operations. A new governance framework is a critical prerequisite if offshore aquaculture is to succeed, that is, to become commercially

viable and environmentally sustainable in the United States. Offshore aquaculture constitutes a new use of ocean space under U.S. jurisdiction. Development of an offshore aquaculture governance framework will need to be crafted with great care to ensure an economically and environmentally sustainable industry. Such a framework must give consideration to effects on ocean ecosystems, competing uses of ocean space (such as fishing, navigation, national defense, conservation, recreation, mineral development), and the public interest.

Aquaculture is defined in the 1980 National Aquaculture Act as “the propagation and rearing of aquatic species in controlled or selected environments, including, but not limited to, ocean ranching.” As noted in Table 1.1, there are various types of aquaculture operations involving hatcheries (land-based facilities to spawn and rear broodstock), nursery culture (the rearing of juveniles to a size conducive to growout), and growout facilities, which bring the organisms to harvest size.

There are two distinct categories of aquaculture in the United States. One meets human consumption needs through farming practices or stock enhancement for commercial or recreational fisheries. The other en-

*The seaward jurisdictions of both Texas and Florida extend 3 marine leagues (about 10 statute miles) into the Gulf of Mexico as a result of Supreme Court decisions involving their historic boundaries (see *U.S. v. Louisiana*, 363, US1 [1960] and *U.S. v. Florida*, 363, US121 [1960]. (Cicin-Sain and Knecht, 2000, p. 21).

Table 1.1 Major Types of Offshore Aquaculture Operations	
<p>Types of Aquaculture by Life Stage:</p> <p><i>Hatcheries</i> Conventional hatcheries involve land-based facilities to spawn and rear broodstock</p> <p><i>Nursery culture</i> This involves the rearing of juveniles to a size conducive to growout</p> <p><i>Growout (Cultivation to harvestable size)</i> Includes shellfish culture, finfish culture, and seaweed culture</p>	
<p>Types of Aquaculture by Organism Type</p> <p><i>Shellfish culture</i> Floating longlines, hanging cages or lantern nets Free planted— “bottom ranching” Bottom cages</p> <p><i>Finfish culture</i> Net pens or sea cages Either for the conventional rearing of hatchery-raised fingerlings or for “fattening” to add value to wild-harvested fish (such as tuna) Including: traditional floating pens submersible possibly mobile Ranching: Release of juveniles that either return or are “trained” to aggregate for harvest</p> <p><i>Seaweed culture</i> Longlines for aquatic plants</p> <p><i>Stock enhancement</i> Typically considered aquaculture, but this is a “gray area”</p>	
<p>Three factors determine if a practice falls within our working definition of aquaculture:</p> <ol style="list-style-type: none"> 1) Aquatic species are being reared or propagated (defined as spawning, feeding, nurturing, predator control, disease prevention, etc.). 2) Some degree of exclusive use of an area is required by the operation. For instance, free planting of shellfish on the bottom does not require a structure and requires little or no husbandry once the seed are released, but to generate the investment in the seed and early husbandry, exclusive harvest rights must be granted. 3) The operation requires placing a structure in the water. 	

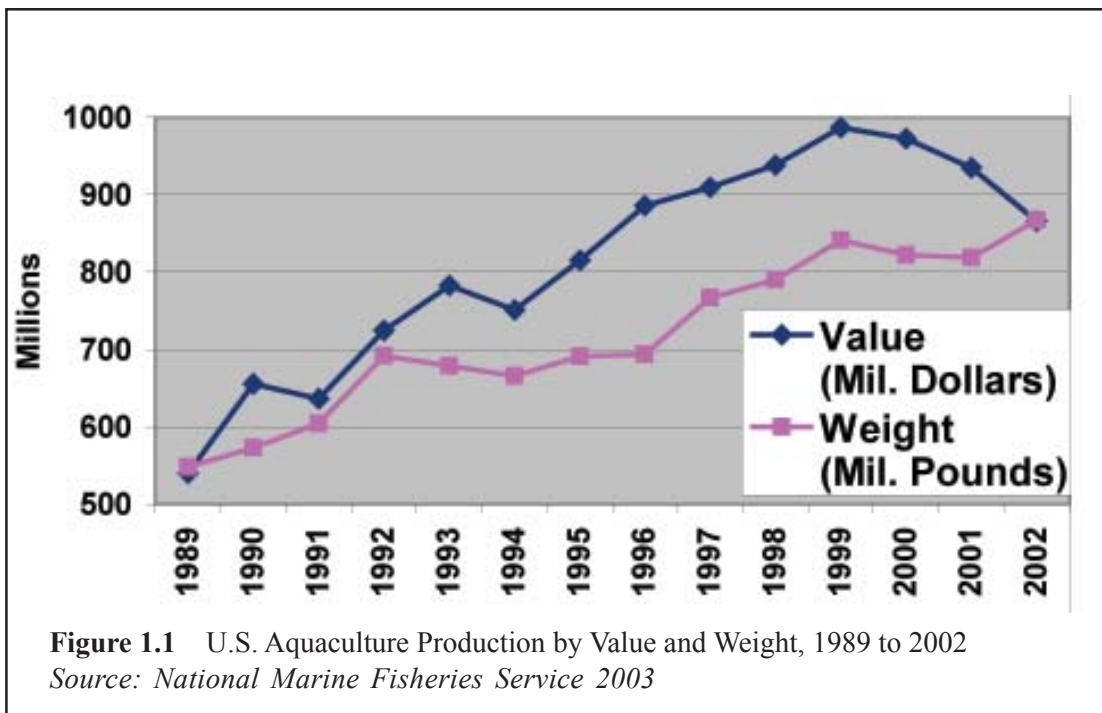
Source: Cicin-Sain et al 2001

compasses a wide range of non-food products, including baitfish, ornamental fish, drugs, research animals, craft materials, leathers, jewelry, and stock enhancement for conservation purposes. Both the food and non-food items contribute to the national economy by boosting employment and providing valuable goods and services (NMFS 2002a).

In 2002, estimated U.S. aquaculture (marine and fresh water) production totaled 867 million pounds, consisting largely of freshwater species (mainly catfish, trout, tilapia, crawfish, and striped bass). Catfish alone accounted for more than 70% by weight and 40% by value of

2002 production. The major marine species (salmon, oysters, clams, shrimp, and mussels) accounted for about 8% of the total production measured by weight and about 18% by value. In Table 1.2, the reader will note both trends and fluctuations across weight (due to changes in harvest) and value (due to both changes in harvest and price changes). Production by weight increased between 1998 and 2002 while the value of aquaculture production declined by 8%, largely driven by lower catfish prices and declines in both salmon harvest and salmon prices (Table 1.2, Figure 1.1).

U.S. aquaculture remains a relatively small industry,



accounting for just over one percent of total aquaculture production worldwide (FAO 2001). Its share of the U.S. seafood market is only about 8-9 percent, compared with an overall share of 26 percent for aquaculture worldwide (FAO 2001). Imported seafood (much of which is farm-raised), now supplies well over half of the annual demand for seafood in the United States. Net seafood imports exceeded \$7 billion in 2003 (about 1.6 % of the total U.S. trade deficit [U.S. Dept. of Commerce 2005]) and more than doubled in the 8 years from 1995 to 2003 (see figure 1.2).

Globally, the proportion of overfished stocks increased approximately tenfold from 1950 to 1994, and approximately threefold from 1974 to 2001 (FAO 2002a). In near parallel, the number of fishermen and fish farmers increased from 13 million in 1970 to 30 million in 1995. Domestically, a number of fish stocks are over-exploited. From 2001 to 2002, the number of U.S. overfished stocks grew from 81 to 86, and the number of fish stocks deemed “not overfished” fell from 163 to 150 (NMFS 2003).

Aquaculture has the potential, if it is properly managed and profitable, to supplement the currently diminished fisheries of the United States and to provide more of our seafood. In fact, over the last decade, the world supply of food and non-food products from capture fisheries has leveled off. The food fish production increase seen worldwide in recent years is entirely attributable

to aquaculture (Grainger 1999).

It is possible, however, that marine finfish aquaculture may contribute to further net depletion of fish stocks worldwide due to nearshore habitat destruction, pollution, non-native introductions, and the use of fish meal and oils in feed (see, for example, Naylor et al. 2000). To avoid potential negative effects, marine aquaculture operations must be governed according to a detailed regulatory framework and environmental review process that considers and mitigates such possibilities. More research on the practicality of various lower-cost, plant-based dietary alternatives to fishmeal needs to be carried out.

Despite the fact that aquaculture is the fastest growing animal food-producing sector in the world (FAO 2002b), current prospects to meet future seafood demand appear grim. The FAO, for example, predicts a gap between supply and demand for fish products, in the range of 10 to 40 million tons by 2010 (Intrafish AS 2000). Aquaculture production, as currently conducted on land and in coastal systems, is far too constrained to meet these production goals.

However, there is potential for supplying farmed seafood to the U.S. market through greater use of the marine environment for aquaculture operations. By virtue of the vast ocean waters under U.S. state and fed-

Table 1.2 Estimated U.S. Aquaculture Production in Weight (Millions of pounds), and Value (Millions of Dollars), 1998-2002.

Weight	1998	1999	2000	2001	2002
Finfish					
Baitfish	16.4	16.4	14.0	14.0	14.0
Catfish	564.4	596.6	593.6	597.1	630.6
Salmon	32.0	39.1	49.4	45.8	28.1
Striped bass	9.4	9.7	11.2	10.9	10.5
Tilapia	18.2	17.8	20.0	17.6	19.8
Trout	55.1	60.3	59.2	56.9	54.5
Shellfish					
Clams	9.7	10.7	9.9	10.0	9.9
Crawfish	37.9	42.9	17.0	30.5	61.3
Mussels	0.5	0.5	0.4	0.7	1.4
Oysters	18.2	18.7	16.8	16.8	18.5
Shrimp (SW *)	4.4	4.6	4.8	8.0	9.0
Miscellaneous	23.5	24.7	26.2	10.7	9.8
Total (% change from year before)	789.7 (+3%)	842.0 (+7%)	822.5 (-2%)	818.9 (-0.4%)	867.3 (+6%)
Value	1998	1999	2000	2001	2002
Finfish					
Baitfish	57.4	57.4	45.8	45.8	45.8
Catfish	419.1	438.9	445.9	386.3	358.1
Salmon	62.7	76.8	99.2	72.0	27.8
Striped bass	24.1	21.9	29.5	28.5	27.9
Tilapia	27.3	26.6	30.0	30.0	19.8
Trout	59.7	65.0	63.7	64.5	58.3
Shellfish					
Clams	29.6	42.1	32.6	35.4	41.8
Crawfish	23.6	28.3	27.6	40.5	50.4
Mussels	2.8	0.8	0.5	1.2	3.2
Oysters	48.0	55.6	42.4	39.9	53.5
Shrimp (SW *)	17.6	13.7	14.6	27.8	27.6
Miscellaneous	166.7	160.0	141.0	162.7	152.0
Total (% change from year before)	938.6 (+3%)	987.1 (+5%)	972.8 (-1%)	934.7 (-4%)	866.1 (-7%)
<i>Notes: Clams, oysters and mussels are reported as meat weights. Some clam and oyster aquaculture is reported with U.S. wild-harvest landings. Weights and values represent the final sales of products to processors and dealers. "Miscellaneous" includes ornamental/tropical fish, alligators, algae, aquatic plants, eels, scallops, crabs, and others. Production value, but not weight, are reported for many "Miscellaneous" species. *SW = Saltwater. Source: National Marine Fisheries Service, Fisheries Statistics and Economics Division, 2003.</i>					

eral control (more than 3.4 million square miles - NMFS 2002a), marine aquaculture has the potential to overtake the production of land-based facilities. A variety of species have already been cultivated successfully under experimental and commercial conditions in different marine regions of the United States. Some examples include: the SeaStead Project off Massachu-

setts involving sea scallops (Smolowitz et al. 1998a and 1998b); the New Hampshire Open Ocean Demonstration Project involving several groundfish species and blue mussels; the culture of Pacific threadfin in Hawaii; and the Snapperfarm Inc. project in Puerto Rico involving the culture of mutton snapper and cobia. Table 1.3 summarizes current and past marine aquaculture

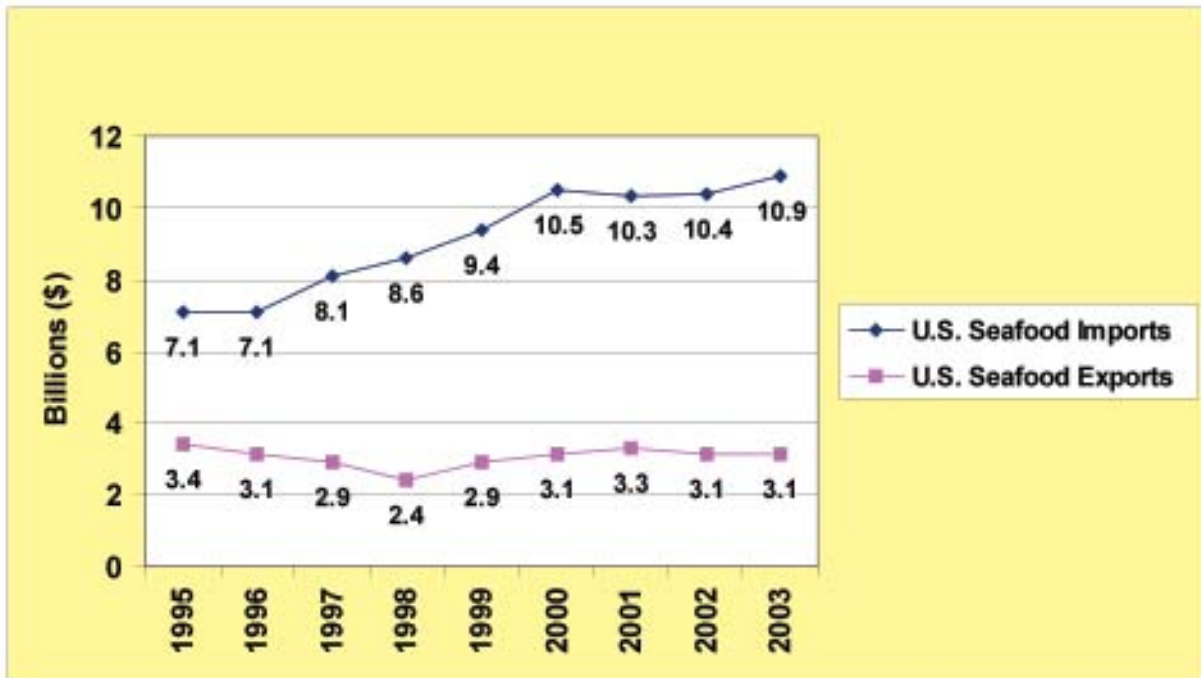


Figure 1.2 U.S. Seafood Trade Deficit 1995-2003

projects, along with two prospective projects noted at the bottom of the table. Some of these projects are located in state waters.

Aquaculture in the marine environment is technologically diverse, with ponds, raceways, silos, circular pools, closed (water reuse) systems, cage and net-pens, sea ranches, rafts and long lines used according to the species cultured (JSA 1983). Aquaculture practices range from extensive, with few inputs and modest yields, to intensive, with high inputs and yields. These diverse technologies have wide-ranging resource needs, produce differing environmental impacts, and require a suite of technological and management responses (DeVoe 2000).

New technologies should provide additional opportunities for the growth of offshore aquaculture. Two new technologies expected to enhance offshore aquaculture are the use of drifting cages (Goudey 1998a, 1998b) and the combination of renewable energy (windmills) with aquaculture. Similarly, advances in disease management, feeding, engineering, and species development may also give the industry a boost. Recent advances in offshore submersible cage technology and marine fish hatchery technology have brought offshore aquaculture from the drawing board to working reality, as evidenced by the currently operational U.S. offshore projects, and other related projects around the globe.

OBSTACLES AND ISSUES CONFRONTING THE DEVELOPMENT OF OFFSHORE AQUACULTURE IN THE UNITED STATES

Marine aquaculture represents a relatively new use of the nation's coastal and ocean areas, and it must compete for access to these areas (Nixon 1994). Newcomers to the industry, as well as local authorities, are often hindered by a lack of experience. The result is poor site selection, inadequate evaluation of market opportunities and product diversification, and a lack of

understanding of marine aquaculture development in relation to other forms of coastal uses (Chamberlain and Rosenthal 1995).

A 1992 National Research Council report on Marine Aquaculture identified factors that complicate development, including: (1) conflict from interaction of marine

Table 1.3 – Offshore and Coastal Ocean Aquaculture Projects

Project	Sponsor	Location	Dates	Technology	Species	Status
Woods Hole Oceanographic Institution Buoy Farm	Woods Hole	10 miles southeast of Martha's Vineyard, Massachusetts (MA)	1999-	Socking Loops	Blue Mussels	Active
American Norwegian	Private	27 miles east of Cape Ann, MA	1988-1994	Net Pens	Salmon	Never Installed
SeaStead	University/private (fed funding)	12 miles southwest of Martha's Vineyard, MA	1994-1999	Bottom culture & suspended nets	Scallops	Ended when funding expired
New Hampshire Open Ocean Demo	NOAA	1.3 miles south of Isles of Shoals- 6 miles off mainland New Hampshire (NH)	1997-	Submersible cages and rafts, submerged longlines	Halibut, Haddock, Flounder, Cod, Mussels	Active
SeaFish	Joint venture with Shell Oil	34 miles off Texas coast	1998-1999	Net pens attached to gas platform	Red Drum	Ended 1999
Hawaii Offshore Aquaculture Research Project/ Cates	NOAA/ Univ. Hawaii/ Oceanic Inst.	2 miles off Ewa Beach (Hawaii)	1999-	Submerged Cages	Pacific Threadfin (Moi)	Active – now run by Cates International
Gulf of Mexico Consortium	NOAA	22 miles south of Pascagoula (Mississippi)	2000-2003	Submerged Cages	Gulf species	No growout. Ended when funding expired
Snapperfarm	Private/Univ. Miami	Puerto Rico	2002-	Submerged Cages	Cobia	Active
BioMarine Technologies	Private	Gulf of Mexico	1989-	Net pens on gas platforms	Cobia, amberjack	R&D, permitting
Aquaculture, Inc.	Private	Gulf of Mexico	2004-	Submerged cages	Cobia, amberjack	R&D, permit denied
<i>Sources: Prepared by Susan Bunsick 2000; Updated by Jason Didden 2005; Gerard J. Mangone Center for Marine Policy</i>						

aquaculture with other marine and coastal activities and interests; (2) marine aquaculture often depends on the use of land and freshwater resources as well as the ocean; and (3) the numerous environmental and regulatory considerations involved in the development and use of coastal zone land and water resources, which are usually held in the public trust (NRC 1992). The discussion below describes these major issues.

Coastal and Ocean Use Conflicts

Use conflicts represent one of the primary issues marine aquaculturists must face in the United States, and use conflicts are likely to become more pronounced and frequent in the future (Chamberlain and Rosenthal 1995, DeVoe 2000). Because of increasing pressures along the coastal zone, recirculating (closed) systems on land and confined systems in the open ocean may prove the

best opportunities for future commercial aquaculture development (NRC 1992). The escalating cost of acquiring access to coastal lands and waters exacerbates the problem. However, despite the emphasis of research and development (R & D) on closed system aquaculture rather than offshore facilities during the past 20 years, the economic viability of closed system aquaculture remains elusive. The United States has only recently begun exploring the potential for establishing facilities in offshore areas.

Aquaculture and the Environment

Much has been published over the last 15 years on the environmental impacts of marine aquaculture. One of the major challenges to the marine aquaculture industry in the United States will be how it responds to these environmental issues (see DeVoe 2000 and deFur and Rader 1995 for representative references).

The environmental effects of aquaculture depend on: (1) techniques applied, (2) site location, (3) scale, (4) capacity of the receiving body of water (Ackefors and Sodergren 1985), and (5) species raised (Eichenberg 2000). Effects can include impacts on water quality, sediment, the native gene pool, other fisheries, and the ecosystem as a whole. Vectors include effluents, introduced culture species, disease, and chemicals (DeVoe 2000, Naylor et al. 2000).

The state of knowledge regarding the environmental impacts of marine aquaculture is rapidly improving. Two decades ago very little information was available, but there has been a surge in the number and scope of research and monitoring programs seeking to document these effects (see, for example, Reichhardt 2000, Naylor et al. 2000 and 1998, Goldburg and Triplett 1997, Webber 1997). Much work worldwide has focused on the effects of net-pen culture on the environment, with the International Council for the Exploration of the Seas (ICES) leading the way. In the United States, early research efforts dealt with fish hatchery effluents and catfish ponds. As the domestic industry has diversified, so has environmental research, with major federal studies examining the impacts of marine shrimp pond culture, salmon net-pen culture, species introductions, the use of chemicals in aquaculture, and effluents. In addition, research has only begun on relevant therapeutic drugs, and other than for salmon, there are no approved drugs or licensed vaccines.

Sustainability is a frequent concern about aquaculture. This fundamental strategic issue often centers on competition for space and effluent discharges, despite the argument that the majority of coastal aquaculture operations are conducted with appreciable social and nutritional benefits despite minor environmental cost (Grainger 1999). Also, the user conflict and environmental problems that constrain the development of aquaculture in nearshore zones may be less problematic in offshore areas (NRC 1992, Grizzle et al 2001, Alston et al 2005).

Legal and Regulatory Issues

The current regulatory environment for offshore aquaculture in the United States is a major constraint to its development (for example, NRC 1978, NRC 1992, JSA 1993, Smolowitz et al. 1998). At the federal level, no formal framework exists to govern the leasing and development of commercial aquaculture activities in federal waters. Overall, aquaculture policy appears to be made by granting permits on a case-by-case basis (Rubino and Wilson 1993). Each permit is considered individually by the issuing agency, usually with no provision for examining cumulative impacts (deFur and Rader 1995). The current framework of federal laws related to aquaculture development has been described as “an unfinished patchwork quilt. All the squares exist but some remain incomplete and they have not been assembled into a pattern or sewn together” (Hopkins et al. 1997, p. 239).

As noted by Hopkins et al. (1997), several federal agencies have asserted authority over open ocean aquaculture under existing federal laws — for example, the U.S. Army Corps of Engineers (under the Rivers and Harbors Act and the Outer Continental Shelf Lands Act); the Environmental Protection Agency (under the Clean Water Act and the Ocean Dumping Act); the National Marine Fisheries Service (under the Magnuson-Stevens Fishery Conservation and Management Act and the Marine Mammal Protection Act); and the U.S. Fish and Wildlife Service (under the Lacey Act Amendments). None of these Acts, however, have been written or established with marine aquaculture in mind, and “considerable uncertainty exists as to whether the agencies’ assertions of jurisdiction over open ocean aquaculture under these statutes, principles and protocols will withstand legal challenge” (Hopkins et al. 1997, p. 240).

The problems arising from the absence of an appro-

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appropriate policy framework for governing aquaculture in federal waters have been evident in several U.S. offshore areas, particularly in New England. Hopkins et al. (1997) recount the difficulties encountered by three projects proposing offshore aquaculture facilities—the American Norwegian Fish Farm, Inc. project (approximately 40 miles off Gloucester, Massachusetts), the Westport Scallop Project (approximately 12 miles off Martha's Vineyard, Massachusetts), and the Sea Pride Industries, Inc. project (approximately 4 miles off Fort Morgan, Alabama). As noted by Smolowitz et al. (1998b, p. 1) with respect to the Westport Scallop Project, “the existing mechanisms cope with rather than direct and channel the gathering energies of our emerging open ocean farming industry in the United States.” In the case of the American Norwegian Fish Farm, for instance, the Conservation Law Foundation of New England contested in court the company's proposal to develop a 47-square-mile salmon farm off Cape Ann. The litigation raised key questions as to whether such an enterprise represents the best use of public waters, whether lease charges should be levied, and whether an environmental impact statement should be required (*National Fisherman* 1991).

Policy and legal issues related to open ocean aquaculture have been examined and discussed in detail in past studies. Regulatory gaps and overlaps have been identified by the Office of Technology Assessment (1994), the Marine Law Institute (Eichenberg and Vestal 1992), and in the results of a symposium on open ocean aquaculture published in a special issue of *Ocean and Coastal Law Journal* (see, for example, Barr 1997, Brennan 1997, Hopkins et al. 1997, Rieser 1997, and Underwood 1997). According to Rieser, the major problems presented by the lack of coherence in the federal framework for offshore aquaculture include: (1) the limited availability of property rights or other interests that can secure a producer's investment; (2) poorly defined standards that fail to reduce conflicts among competing users of public resources; (3) poorly defined agency jurisdictions leading to delays in applying standards or regulations; (4) the existence of redundant regulations due to overlapping agency responsibilities; and (5) inappropriate restrictions designed to protect wild stocks (Rieser 1997).

In addition to deliberations and writings by academics, nongovernmental organizations (NGOs), and others noted above, the need to create an appropriate offshore aquaculture governance regime has also been

raised with increasing frequency and urgency by the federal government itself. In the late 1990s, the federal agencies involved in the interagency Joint Subcommittee on Aquaculture (JSA), as well as a National Oceanic and Atmospheric Administration (NOAA)/Department of Commerce Aquaculture Task Force, began to consider the question of possible governance frameworks for offshore aquaculture (JSA undated (a), Mieremet 2000). Several congressional bills proposing an offshore aquaculture policy framework have been introduced and considered (for example, Senate Bill 1192—the Marine Aquaculture Act of 1995), but none have been enacted. The National Offshore Aquaculture Act of 2005 (S 1195) is currently before Congress and will be described later in this chapter.

Before investing millions of dollars, potential investors will need information about the regulatory requirements and associated costs. Where will such projects be allowed? On what basis will they be approved? Which agencies and levels of government will be involved? What possible up front and annual fees can they expect to pay? Before accepting a new program that would allocate rights to exclusive use of ocean space, the public will also need to be assured that existing rights, uses, and benefits are adequately protected. What environmental protection measures will be required? Which areas will be protected? How will the rights of competing users be protected? Will the public be adequately compensated?

The Absence of Federal Policy

McCoy (1989) argues that Federal agencies, by adopting vague, confusing, and poorly conceived regulations (or none at all), have helped create major problems for aquaculture at the state level due to the resulting lack of uniformity of laws among states, the sheer number of permits, licenses and certifications that must be obtained, and the difficulty in obtaining them. Few states have a comprehensive regulatory plan that satisfactorily balances economic development and environmental protection. Complicating matters is the fact that existing permit programs do not have provisions for determining the capacity of the coastal ecosystem for aquaculture (deFur and Rader 1995). Each state has its own unique legal, political and economic climate for aquaculture, and as a result, culturists must navigate the regulatory environment differently in each state.

Some states still apply laws designed for other applications, such as those for public fisheries management and agriculture (Ewart et al. 1995). Even federal laws are applied differently in various geographic regions of the country, and the industry remains concerned about the lack of coordination among agencies regulating aquaculture (Smolowitz et al. 1998).

Policy development for aquaculture management in federal offshore waters can also benefit from comparisons with efforts in other countries—such as Canada, the United Kingdom, Ireland, Norway, Chile, Australia, New Zealand, Japan, and China—that have more highly developed aquaculture industries (see, for example,

NRC 1992, Appendix A; OECD 1989b; British Columbia Environmental Assessment Office 1997; Norway 1994-1995; FAO 2003a). Additionally, international organizations such as the UN Food and Agriculture Organization (FAO) have developed guidance on the conduct of aquaculture operations (see, for example, FAO 1999), which may be useful in structuring aquaculture policy for U.S. ocean areas. The drafting by the U.S. Department of Commerce and NOAA of a Code of Conduct for offshore aquaculture in federal waters has benefited from cross-national comparison, as well as from collaboration between the United States and the UN FAO in the development and adoption of an international Code of Conduct for marine fishing (NMFS 2002b).

MAJOR FINDINGS OF 2001 MULTIDISCIPLINARY STUDY ON OFFSHORE MARINE AQUACULTURE

Major Purpose and Orientation of 2001 Study

In the period 1999-2001, a multidisciplinary team led by researchers at the Gerard J. Mangone Center for Marine Policy at the University of Delaware (comprised of 8 ocean and policy/law specialists, aquaculture scientists, and an aquaculture industry member) undertook a study (with support from NOAA and the National Sea Grant Program), to examine the major issues surrounding the expansion of the aquaculture industry offshore and to develop the key features of a national ocean policy framework for offshore aquaculture. The project benefited greatly from the feedback and advice provided by an advisory committee, composed of distinguished individuals from Congress, state and federal agencies, the aquaculture industry, fishing industry, and environmental groups (see Cicin-Sain et al 2001).

The team studied and drew lessons from: 19 past studies of aquaculture policy; 6 case studies of actual experiences with offshore aquaculture facilities; the experiences of 22 coastal states and territories; the experiences of 8 other countries (Australia, Canada, Chile, Ireland, Japan, New Zealand, Norway, and the United

Kingdom); and the experiences and prescriptions of international organizations such as the UN Food and Agriculture Organization (FAO) and the International Council for the Exploration of the Seas (ICES). The collective knowledge gained from these sources was then directly applied to the development of a draft policy framework for offshore aquaculture. The team focused especially on the federally-controlled ocean zone, extending from the limits of state control (3 nautical miles offshore for most states) to the 200-mile limit of the U.S. Exclusive Economic Zone (EEZ).

The resulting report (available from the Gerard J. Mangone Center for Marine Policy), *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone* (Cicin-Sain, B. , S. M. Bunsick, M. R. DeVoe, T. Eichenberg, J. Ewart, H. Halvorson, R. W. Knecht, and R. Rheault), presents a comprehensive assessment of federal policy with respect to the development of aquaculture in federal waters, and is the work that provides the background to the current report.

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The 2001 report revealed three critical themes that hinder the development of offshore aquaculture in the United States:

- The absence of a well-defined and efficient policy framework, which fulfills public trust responsibilities in public waters (public waters are legally held “in trust” by the government for the benefit of the public) while offering a predictable review, permitting, leasing, and monitoring process to the marine aquaculture industry;
- Concern with environmental impacts, the absence of a well-defined system of environmental review of offshore aquaculture projects, and the need to adopt strategies for avoiding and mitigating such impacts; and
- The importance and controversy of granting exclusive or semi-exclusive rights to particular ocean areas for marine aquaculture operations, while addressing conflicts with either other ocean users or the above mentioned public trust responsibilities

Few federal statutory authorities address aquaculture directly or the specific issues associated with offshore aquaculture. As noted earlier, with few exceptions, federal authority over offshore marine aquaculture is based on agency interpretation of statutory authority over particular aspects of an aquaculture operation. This fragmentation results in the industry having to meet many different requirements from federal (and state) agencies in a process that is not clearly intelligible and is often subject to legal challenge.

Furthermore, without a lead agency for offshore aquaculture, conflicts between regulatory agencies frequently occur. Environmental review requirements for offshore aquaculture are ad hoc and often insufficient, frequently incurring legal challenge. There is no established process for assessing the impacts of offshore aquaculture on other ocean uses, and no established mechanisms for obtaining public input on offshore aquaculture development proposals. There is no established system of offshore aquaculture leasing to give the aquaculture operator either security of tenure or an exclusive or semi-exclusive right of operation, nor is there a mechanism to compensate the public for the use of public waters. Additionally, there is not a standard for aquaculture best management practices that can serve to guide operators and government agencies alike.

The review of relevant experiences in U.S. coastal states conducted through the 2001 study revealed lessons applicable to offshore aquaculture in federal waters. First, in a number of cases, states have designated lead agencies for aquaculture. Most have some type of marine aquaculture leases (involving payment of fees, bonds, etc.), and require public hearings and environmental review for aquaculture applications. Washington has been a leader in the permitting process and early BMPs. In Florida, Maine, Mississippi, and Alaska, the permitting process for aquaculture development has been streamlined into a single multi-agency permit that includes certification by the state’s coastal zone management program. In Maine and Florida, inter-agency committees for aquaculture management have been formally designated. Florida has created best management practices for aquaculture, which include compliance with clean water standards as well as regulations for the culture of non-native species. New Hampshire, Maine, Mississippi, and Hawaii have created very detailed procedures for environmental assessment and monitoring, including, for example, in New Hampshire, criteria for “unacceptable risk” and for reporting of “unusual events.” Lastly, the 2001 survey results revealed that ten states have addressed aquaculture in their coastal zone management plans.

The 2001 review of the policy frameworks in other nations active in offshore aquaculture, and of the policy guidance offered by international organizations such as the FAO, suggested a number of lessons and echoes many of the themes evoked in the practices of the U.S. coastal states. As in Hawaii, one of the themes emphasized in other nations (for example, in Norway and Chile) is the importance of a formal planning process for the designation of areas suitable (or not suitable) for aquaculture development and the use of site-selection criteria, including spacing requirements between farms. A number of other nations (for example, Australia and Japan) have created streamlined inter-agency processes, a lead agency, and aquaculture development plans.

The international experience stresses the precautionary approach. For example, in the guidelines provided by the FAO and in requirements in effect in Norway, it is the responsibility of the fish farmer to demonstrate that a farm will not cause unacceptable pollution effects. Criteria for determining capacity, in terms of number and density of fish to be safely allowed, have been developed.

Criteria Guiding Recommended Policy Framework

The 2001 study proposed a broad policy framework, taking into account useful features of approaches suggested in past studies and of lessons learned from the experiences of the coastal states and of other nations. The framework seeks to ensure that marine aquaculture activities that occur in U.S. offshore waters take place in an environmentally safe and sensitive manner with due respect for the legitimate interests and activities of others. Also, in view of the fact that little information on the possible impacts of offshore aquaculture is yet available, the framework must be adaptive in nature, evolving over time as additional data and information are obtained. A policy framework for offshore aquaculture should:

1. Encourage responsible open ocean aquaculture in the U.S. Exclusive Economic Zone (EEZ);
2. Promote a decision-making process that is efficient, coordinated, and predictable;
3. Employ a precautionary approach to avoid and minimize environmental impacts and promote integration into the ecosystem;
4. Apply separate criteria to native and non-native species;
5. Be consistent with existing U.S. laws and agency responsibilities;
6. Be equitable and fair to offshore aquaculture and to other U.S. users of the EEZ;
7. Be consistent, to the maximum extent possible, with the coastal, water, environmental, and aquaculture policies of adjacent coastal states;
8. Be consistent with U.S. obligations under international agreements;
9. Fit within an overall framework for sustainable development of the U.S. EEZ;
10. Produce a fair return to the public for the use of federal ocean space;
11. Be conducted in a transparent manner with opportunities for public involvement;
12. Be adaptive and promote opportunities for innovation, data collection, and learning.

Outline of Major Features of the Proposed Policy Framework

The 2001 study proposed that a policy framework should incorporate the following major features:

- Offshore aquaculture regulations should be streamlined and harmonized and a single, multi-agency permit for aquaculture in offshore waters should be established. In conjunction with the streamlining of regulations, the respective roles of federal and state agencies should be reconciled and clarified.
- Appropriate planning to identify suitable (and non-suitable) areas for offshore aquaculture, avoiding projects that damage environmentally sensitive areas as well as avoiding undue interference with other users (navigation, national defense, fishing, recreation, etc.), should take place before areas are offered for aquaculture leasing.
- A leasing system which, on the basis of a preliminary plan provided by the aquaculture firm, gives the firm exclusive or semi-exclusive right (of limited time duration) for exploration and further development of an operational plan, should be established. Lease provisions should be consistent with public trust responsibilities and preference shall be given to firms capable of demonstrating an approach that not only prevents and reduces the production of pollutants but also limits escapes. There should be an expectation that private users of public waters provide some compensation to the public in return for the exclusive or semi-exclusive right to occupy public ocean space.
- A thorough environmental review process to assess the potential environmental impacts of the project and to develop appropriate mitigation measures should be put in place.
- The leasing, permitting, and environmental review processes should be conducted in an open and transparent manner with opportunities for participation by the public and by affected interests.
- A monitoring process, which may involve conditions on operations such as insurance, bonds, or environmental monitoring requirements, should be put in place to insure sound operations, and, in the case of termination of operations, the removal of structures and the return of the area to its previous state.

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- A lead federal agency for overseeing the management of offshore aquaculture in the EEZ should be named.

THE CURRENT STUDY

Major Purpose and Orientation of Current Study

The purpose of the present study is: 1) to make the draft policy framework developed in the 2001 study more operational and implementable; and 2) to build consensus among national and regional level stakeholders on desirable options to be included in the framework. In the current study, the former eight-member project team was expanded into a 13-member team, with additional ocean policy and law specialists as well as an additional state aquaculture coordinator, adding new perspectives from environmental groups, coastal states, and industry.

In September 2002, this multidisciplinary team held a national workshop in Washington D.C. to receive feedback on the detailed development of the operational framework. At this workshop, federal agencies with regulatory roles in offshore aquaculture, along with Congressional staff and other relevant parties, convened to discuss the numerous options for addressing each of the following seven aspects related to the development of offshore aquaculture operations:

1. Administration and implementation procedures for aquaculture in federal waters, including the designation of a lead agency as well as the roles of other federal agencies;
2. Guidelines and principles for issuing both short-term and long-term leases, granting the aquaculturist the exclusive or semi-exclusive right to ocean space, contingent upon conditions and rents;
3. Guidelines for joint state/federal permitting, including the use of a single, comprehensive appli-

cation form to meet the requirements of all involved agencies;

4. Planning and site assessment procedures, including zoning techniques and mapping tools;
5. Guidelines and principles for efficient environmental review, which involve the ability to detect, prevent, and mitigate harmful environmental impacts;
6. Operation and monitoring procedures, involving such issues as insurance, bonds, monitoring requirements for operational safety, removal of structures, and the return of the site to its previous state following project termination; and
7. Guidelines for effective compliance and enforcement, which provide the aquaculturist freedom to operate within the lease area while preserving the integrity of the ecosystem.

In addition to incorporating the considerations of national-level stakeholders into the operational framework, the team vetted the operational framework at workshops in the three regions that currently exhibit the most extensive involvement in offshore aquaculture: New England; the Gulf of Mexico; and the Pacific Coast and Pacific Island region. Valuable feedback from relevant stakeholders at these workshops has enabled the team to refine and adapt the national-level framework to the varying contexts of these U.S. regions. Table 1.4 displays the five regional workshops on the development of offshore aquaculture that were held by the research group.

Table 1.4 Offshore Aquaculture Regional Workshops

U.S. Region	Regional Workshop	Location	Date
Gulf of Mexico	Gulf of Mexico	Biloxi, Mississippi	September 10-12, 2002
New England	Maine	Hallowel, Maine	September 13, 2002
New England	Massachusetts	Massachusetts Maritime Academy	September 17, 2002
Pacific Coast and Islands	Hawaii	Honolulu, Hawaii	October 3, 2002
Pacific Coast and Islands	Seattle	Seattle, Washington	October 25, 2002

Source: Prepared by Meredith Blaydes, Mangone Center for Marine Policy, Univ. of Delaware, 2003.

A NEW NATIONAL DIALOGUE ON U.S. OCEAN POLICY

Our analysis of offshore aquaculture takes place in the context of an ongoing and much larger review of U.S. ocean policy. In the last three years and for the first time in over thirty years, comprehensive analysis of U.S. ocean management was completed, not by just one but by two separate commissions, the Congressionally-established U.S. Commission on Ocean Policy (USCOP) and the private Pew Oceans Commission. As part of their analysis, both Commissions described the state of marine aquaculture and provided recommendations for improved management. Both commissions envisioned the bulk of aquaculture industry growth occurring in offshore areas. In addition, the Bush administration included several points in its response to the recommendations of USCOP related to advancing offshore aquaculture.

Because of the importance of the work of the two commissions, completion of this report was postponed to enable the authors to include the recommendations of the two ocean commission reports in the present study. In many ways this report builds upon the issues identified by USCOP and the Pew Oceans Commission, and provides a more detailed operational framework for sustainable offshore aquaculture that is largely consistent with the recommendations of both commissions. The following sections provide more detail on these important reports and also outline The National Offshore Aquaculture Act of 2005 (S. 1195) and EPA's 2004 Effluent Guidelines for Concentrated Aquatic Animal Production Point Sources.

U.S. Commission on Ocean Policy

To address deficiencies in the current ocean management scheme, Congress passed and President Clinton signed the Oceans Act of 2000. The act mandated that a U.S. Commission on Ocean Policy (USCOP or "the Commission") evaluate the state of U.S. coasts and oceans, their management, and suggest proposals to establish effective and coordinated ocean policy.

USCOP consisted of 17 members, mostly from industry and academia, and like the Pew Commission, all brought high-level ocean-expertise to the Commission. The Commission also had a 26-member, expert science advisory panel composed of well-known experts in various ocean-related fields.

As described by its Chairman, the USCOP report "contains balanced and practical proposals for the establishment of a comprehensive and coordinated ocean policy for our nation" (Front matter, USCOP 2004). The 500+ page report provides a detailed description of many critical ocean problems and various ways to address the problems. Seven pages are devoted to "Setting a Course for Sustainable Marine Aquaculture" (Chapter 22).

The USCOP chapter on marine aquaculture begins by predicting increased seafood demand and cites marine aquaculture as way to meet increasing demand. The USCOP outlines roughly the same environmental

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concerns as the Pew study, but then goes on to focus on problems with the “management structure” for marine aquaculture. Like our report, the USCOP envisions the future growth of marine aquaculture to be offshore, where there is a “regulatory conundrum” due to the myriad and overlapping regulatory authorities. USCOP stresses that marine aquaculture policy should develop “within the context of overall ocean policy development, taking into account other traditional, existing, and proposed uses of the nation’s ocean resources.” USCOP sees the current management system as “characterized by complex, inconsistent, and overlapping policy and regulatory regimes administered by numerous state and federal agencies” (p. 332 USCOP 2004). This system holds back the development of offshore aquaculture in several ways, including increasing uncertainty about exclusivity of use, decreasing capital funding, and making insurance difficult to obtain.

USCOP sees the aquaculture industry focusing development in offshore areas to reduce conflicts associated with aesthetics, fisheries, recreation, and environmental problems, which are relatively more common when marine aquaculture is developed nearshore. The USCOP report, however, acknowledges additional problems of logistics, extreme weather, and hazards to navigation posed by operating in offshore areas.

To enable marine aquaculture to reach its potential, USCOP recommends three areas of action:

First, the United States needs a coordinated and flexible management framework involving government, industry, and academia that acknowledges the differences between land-based and marine-based operations. Congress should legislate a new Office of Sustainable Marine Aquaculture in NOAA to coordinate marine aquaculture and implement a leasing system similar to the one described in Chapter 3 of this report. NOAA would be the lead agency for marine aquaculture.

The leasing system should balance industry and environmental concerns, coordinate with state regulations, collect rents, use a single permit application and review process, require performance bonding, require adaptive best management practices (BMPs), and be “well coordinated with other activities in federal waters.” A key prerequisite for sufficient coordination to occur will be clarification of the roles of relevant federal agencies, and streamlining of “duplicative or outdated laws.” States should also be included in the scope of neces-

sary coordination, and be brought into the development process of a new national aquaculture management framework.

Second, increased investment in research into sustainable marine aquaculture, training, extension, and technology transfer can assist the development of a sustainable marine aquaculture industry. Key areas needing work include environmental and socio-economic impacts of marine aquaculture, risk assessment, species selection, general marine aquaculture technology, and best management practices. NOAA’s new Office of Sustainable Marine Aquaculture would prioritize funding.

Third, the United States should encourage international adoption of aquaculture practices set forth in the United Nations Food and Agriculture Organization (UN FAO) Code of Conduct for Responsible Fisheries. (Ch 22, USCOP 2004) Without commitment to sustainable aquaculture, the growing international aquaculture industry has the potential to negatively affect the global environment in much the same ways listed above for domestic concerns, but on a much greater scope.

The U.S. Ocean Action Plan: President Bush’s Response to the U.S. Commission on Ocean Policy

President Bush’s Administration was required to reply to the USCOP and the reply noted significant obstacles to development of aquaculture in US federal waters. Specifically, the response indicated Administration support for three key items. First, in the 109th Congress the Administration will support a National Offshore Aquaculture Act giving the Department of Commerce “clear authority to regulate offshore aquaculture.” The Department of Commerce will “assist” approvals for offshore aquaculture projects while also ensuring environmental sustainability and managing user conflict. Second, the Administration recognizes EPA authority to regulate offshore aquaculture effluents via the National Pollutant Discharge Elimination System (NPDES) System. Third, the Administration will encourage sustainable aquaculture in the Americas via two workshops in South America (CEQ 2004).

Pew Oceans Commission

The Pew Foundation, the David and Lucile Packard Foundation, the Rockefeller Brothers Fund, and the Oxford Foundation funded an 18-member Commission to conduct a “careful review of the laws, policies, and institutions affecting life off our shores” (in Foreword by the Commission’s Chair, Leon Panetta). Members were primarily from non-governmental organizations, academia, or elected offices, with some representation from commercial fishing and other industries. Each member typically brought a variety of high-level ocean-related experiences to the Commission.

The Pew report, *America’s Living Oceans: Charting a Course for Sea Change*, describes itself as “[outlining] a national agenda for protecting and restoring our oceans,” and as “a vision that projects an equilibrium of goods withdrawn from and goods regenerated within the ocean” (p. ii, Pew Oceans Commission 2003). Chapters 6 and 14 provide, respectively, background and detailed recommendations on “Guiding Sustainable Marine Aquaculture.”

The Pew Report predicts that marine aquaculture is on the verge of a major expansion related to the use of offshore areas, and identifies two key risks from marine aquaculture. First, marine aquaculture poses risks to wild populations, stemming from a variety of factors including invasive escaped species, disease incubation, genetically modified organisms (GMOs), and harvest of wild stocks to supply feed. The threat may be especially strong to populations that are already endangered such as wild salmon in Maine and the Pacific Northwest.

Second, there are risks to water quality since water typically can flow through marine aquaculture operations, carrying effluents to nearby areas. Specific pollutants include nutrients from feed and wastes, antibiotics, herbicides, hormones, anesthetics, pigments, minerals, and vitamins.

The Pew Report cites both the lack of comprehensive governance and the failure of agencies to act where they do have authority as key problems. The Pew Report also notes the lack of a federal framework to administer leasing and development of offshore aquaculture. Pew’s recommendations advocate a new national marine aquaculture policy based in legislation that regulates marine aquaculture on sound environmental prin-

ciples. The legislation would include national standards and authority for the siting, permitting, design, and operation of ecologically sustainable marine aquaculture facilities. A proposed National Oceans Agency or NOAA would be the lead agency, focusing on four themes (Pew Oceans Commission, 2003):

First, adopt national and regional standards to minimize negative environmental effects. A national ocean agency’s standards should focus on ecosystem health and sustainability. Standards should be geared toward minimizing aquaculture’s negative environmental effects, closely considering siting criteria, discouraging the use of other fish for feed, and mostly limiting cultured species to those native to the local area.

The Pew Oceans Commission recommends that the U.S. EPA develop national guidelines to prevent degradation of public waters from aquaculture effluent. These guidelines would be rooted in the Clean Water Act and require National Pollution Discharge Elimination System permits to control all possible pollutants. The EPA would also develop water quality standards for federal waters.

Regional ocean governance councils (to be created) should customize regulations for local needs to be as strict or stricter than the national guidelines. Cumulative impacts, compliance, enforcement, accountability, incentives, and conflict management would be addressed through the regional councils.

Second, the Pew Oceans Commission recommends increased research in sustainability issues, closed systems, polyculture, and more ecologically friendly feed. The National Academies of Sciences would delineate specific national research priorities, and research should inform decision-making.

Third, the Pew Commission recommends a moratorium on the use of GMOs and on the expansion of marine finfish farms until sufficient environmental standards are in place. Once such standards are in place, siting decision responsibility would rest with the Secretary of Commerce.

The Pew Report also encourages the use of foreign policy, including trade restrictions, to encourage sustainable marine aquaculture internationally.

The National Offshore Aquaculture Act of 2005 (S. 1195)

Given the timing of publishing, this report only describes the National Offshore Aquaculture Act (the Act) and it is left to the reader to analyze differences between our recommendations and provisions of the Act. The Act leaves many details for later rulemaking after enactment of the legislation. The text and status of the bill can be found at <http://thomas.loc.gov/cgi-bin/bdquery/z?d109:s.01195:>. The core provisions of the Act are contained in the following sections:

Section 4 - Mandates permits for offshore aquaculture operations and authorizes the Secretary of Commerce to develop the permitting process and associated regulations with other federal agencies and States. Two permits would be required: a site permit and an operating permit that are concurrently submitted and reviewed with a 120-day permit decision requirement. Permits for standard projects would be for 10 years, renewable in 5-year periods, and would require full removal of related structures and possible remediation upon termination. The Secretary, in permits, must specify the terms, conditions, restrictions, duration, size, and location of offshore aquaculture facilities. The Act requires the concurrence of the Secretary of the Interior for permits at or within one mile of facilities permitted under the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. 1331 et seq.), and specifies that nothing in the Act negates obligations to decommission facilities permitted under the OCSLA. The Secretary of the Interior is granted authority to enforce additional conditions to ensure compatibility with the OCSLA by aquaculture operations associated with OCSLA facilities. This section also specifically excludes aquaculture conducted in federal waters from the definition of fishing under the Magnuson-Stevens Act and grants the Secretary of Commerce the authority to collect application and permit fees and bonds as well as the authority to modify or suspend permits.

Section 5 - Instructs the Secretary of Commerce to identify existing laws and regulations related to environmental requirements of offshore aquaculture and allows but does not require the Secretary of Commerce to establish additional environmental and monitoring requirements.

Section 6 - Allows the Secretary of Commerce to establish a research and development program to develop offshore aquaculture technologies that are compatible

with the protection of marine ecosystems.

Section 7 - Instructs the Secretary of Commerce to coordinate with other federal agencies to streamline the process of permitting and regulating offshore aquaculture facilities. Also, excepting tax laws and laws inconsistent with other federal laws and regulations, indicates that the laws of the nearest adjacent coastal State apply to offshore aquaculture facilities (federal enforcement).

Section 8 - Authorizes appropriations to carry out the National Offshore Aquaculture Act.

Sections 9-13 - Establishes authority to enforce provisions of the Act and associated permit stipulations, including arrest, search, seizure, permit sanctions, civil and criminal penalties, and forfeiture. Civil penalties are capped at \$120,000 per day per violation and civil judicial penalties are capped at 240,000 per day per violation. Criminal penalties of five years imprisonment and \$500,000 for individuals (\$1 million otherwise) are available for certain violations.

EPA Effluent Guidelines- 40 CFR Part 451

Effective September 22, 2004, EPA promulgated Clean Water Act effluent limitation guidelines (ELGs) and new source performance standards for concentrated aquatic animal production (CAPP) facilities. As with the National Offshore Aquaculture Act, comparative analysis is left to the reader. Most relevant to this report, the ELGs establish technology-based narrative limitations and standards (described below) for effluent from net pen aquaculture facilities producing 100,000 pounds or more of aquatic animals per year. Molluscan shellfish operations are not subject to these rules. Numeric limits on pollutants, limits on species cultivated, and specific monitoring requirements are not included in the ELGs.

EPA estimated that, every year, the CAPP ELGs would reduce total suspended solid discharges by 0.5 million pounds, reduce biochemical oxygen demand and nutrient discharge by 0.3 million pounds, cost commercial facilities \$0.3 million, cost public hatcheries \$1.1 million, and provide environmental benefits of \$66,000 to \$99,000.

The requirements of the EPA ELGs for net pens can be organized into the following categories:

Drugs - Permittees must provide notification of the use of investigational or new animal drugs or extralabel drug use if use may lead to a discharge of the drug.

Structural Failures - Permittees must notify when there is a reportable structural failure, as specified in the NPDES permit.

Spills - Permittees must notify of spills of drugs, pesticides or feed that result in a discharge.

Best Management Practices (BMP) Plan - Except for certain rearing and release of native species, permittees must develop BMPs to:

(a) Use techniques to limit feed input to the minimum amount and minimize the accumulation of food under pens.

- (b) Properly dispose of packaging materials and gear.
- (c) Minimize discharges during animal transport and harvesting.
- (d) Dispose of mortalities to prevent discharges.
- (e) Properly store drugs, pesticides and feed to prevent spills, and implement procedures for mitigating spills.
- (f) Conduct regular inspection and maintenance of the production systems.
- (g) Document feed amounts, estimates of production, net changes, inspections, and repairs.
- (h) Train in spill prevention, spill response, and proper operation and cleaning of production systems.

ORGANIZATION OF THIS REPORT

Chapter 2 examines the options for administration and implementation of offshore aquaculture, focusing on the roles of federal agencies (including a new NOAA Office of Offshore Aquaculture) in regulating offshore aquaculture activities. We provide the rationale behind creating the NOAA Office of Offshore Aquaculture, and discuss the responsibilities and staffing requirements of such an office. We also describe the relationship of the new NOAA Office of Offshore Aquaculture to NOAA line offices and other federal agencies. All other permitting authorities would be asked to cooperate with the NOAA Office of Offshore Aquaculture in developing a joint lease/permit application. Chapter 2 also includes a discussion on potential jurisdictional issues and conflicts including NOAA enforcement under the Magnuson-Stevens Act, NOAA-Army Corps of Engineers-Coast Guard conflicts, and issues involving the EPA and the Clean Water Act. Chapter 2 concludes with a discussion of how an offshore aquaculture framework could serve as a model for an agency that addresses federal waters issues.

Chapter 3 begins by describing the current legal and regulatory regimes for offshore aquaculture leasing and permitting. We show how, in the absence of an explicit legal and regulatory framework for offshore aquaculture, aquaculture entrepreneurs will most likely find numerous and time-consuming obstacles in consulting all appropriate state and federal agencies and ultimately obtaining all required approvals. We delineate the pros

and cons for joint or separate leasing and permitting and detail a proposed joint lease/permit application process. We review the philosophy, guiding principles, and general provisions for leasing offshore sites to aquaculture operations. The Minerals Management Service's experiences in administering a leasing system are described as an example of how to structure offshore leasing. We consider two options for permitting aquaculture facilities: Section 10 of the Rivers and Harbors Act as the primary aquaculture permit; or a new aquaculture lease that contains operational parameters, with a reduced role for the Army Corps under Section 10, settling on the latter. Recommended lease types are described, as well as various terms and conditions needed for successful implementation. Chapter 3 concludes with a discussion of federal agency consultation and coordination requirements.

In *Chapter 4* of the report, we discuss planning and siting of offshore aquaculture facilities. Advanced planning can prove crucial for: determining appropriate locations and scales of production; reducing user conflicts; and preventing development in environmentally unsuitable areas. Key elements of planning such as surveys, socio-economic and environmental impact analysis, engineering, legal and regulatory requirements, public input, and an Offshore Aquaculture Operational Business Plan are described. We also examine how Geographic Information Systems (GIS) and siting criteria can be useful. Six specific options for siting are

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illustrated: site-specific leases, pre-permitted sites, pre-approved areas, zoned areas for multiple uses, marine aquaculture parks, and complete mapping/zoning. Chapter 4 concludes by returning to the idea that aquaculture management needs to be part of a larger framework for managing the U.S. federal waters.

Chapter 5 discusses the potential environmental impacts of offshore aquaculture and guiding themes for environmental review. Our six guiding themes are: sustainability, precautionary approach, environmental carrying capacity, environmental assessment and monitoring, adaptive management, and public participation and transparency. The most important potential negative environmental effects include: exceeding the carrying capacity of an ecosystem, pollution from waste effluents, introduction of diseases and alien species, habitat degradation, and competition with and/or genetic alteration of native populations resulting from interaction with aquaculture escapees. We present potential steps for mitigation (through siting, facility design, stock character and density selection, feed characteristics, disease management, polyculture, and biosecurity) and review both national and international guidance for proper environmental management. Our recommendations center on how best to implement environmental review in offshore aquaculture operations.

Chapter 6 begins with the rationale behind facility monitoring as well as the requirements for effective implementation. We discuss the types of data to be collected (baseline, outcome and performance indicators), as well as possible monitoring requirement details for offshore aquaculture including analysis, inspection, auditing, discharge monitoring, environmental monitoring, self-monitoring, survey design, and confidentiality. We provide a recommended monitoring strategy, including both water column and seabed monitoring that focuses on nutrients, dissolved oxygen, medicines, and chemicals.

Chapter 7 investigates the issues and options surrounding enforcement. We recommend that Codes of Conduct and Best Management Practices guide offshore aquaculture operations and examine management options for the agencies presiding over aquaculturists. We analyze environmental quality standards as the basis for regulatory interventions and possible regulatory instruments and economic incentives to be employed by the regulator. The recommendations in this chapter support adaptive assessment and evaluation. We conclude Chapter 7 with penalty options in response to proscribed monitoring results and/or unacceptable impacts resulting from aquaculture activities.

CHAPTER

2



ADMINISTRATIVE RESPONSIBILITY FOR OFFSHORE AQUACULTURE

OVERVIEW OF PROPOSED ADMINISTRATIVE FRAMEWORK

The proposed administrative framework provides the organizational structure and resources necessary to create and implement the leasing, permitting, planning, environmental review, monitoring and enforcement activities that comprise the federal offshore aquaculture program described in this document. Administrative authority, responsibility, and accountability must reside in some governmental unit. The framework:

- Establishes a new Office of Offshore Aquaculture within the National Oceanic and Atmospheric Administration (NOAA), as the organization with overall responsibility for the federal government's offshore aquaculture program;
- Grants federal planning, leasing, environmental review, monitoring, and enforcement authority for offshore aquaculture to NOAA's Office of Offshore Aquaculture;
- Maintains most existing federal agency authorities for establishing permit requirements and making permitting decisions under current law; and
- Establishes memoranda of understanding/ agreement (MOUs/MOAs) or similar agreements to clarify jurisdictional lines, as well as working relationships between NOAA's Office of Offshore Aquaculture

and other federal agencies that maintain relevant roles in the implementation of the planning, leasing, permitting, environmental review, monitoring, and enforcement system for offshore aquaculture.

The proposed administrative framework is designed to provide an effective and efficient organizational structure for implementing the key aspects of the proposed policy framework described in other sections of this report. It does this by:

1. Organizing planning, leasing, and permitting activities.
 - Planning and leasing activities are essentially aimed at enabling the development of the aquaculture industry, while permitting activities are regulatory in nature in that they focus primarily on ensuring that aquaculture development does not unduly interfere with other users, stakeholders, the environment, and other national interests.
 - The lead program office has a specific offshore aquaculture mission and the leasing authority needed to accomplish its mission.
 - The regulatory system acknowledges and preserves the existing regulatory authorities of multiple agencies of the federal government.

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2. Using MOUs, MOAs, or similar agreements to clarify jurisdictional lines and establish efficient administrative mechanisms for implementation of the permitting, monitoring, and enforcement activities.

3. Eliminating the need for wholesale transfer of regulatory authorities for which administrative systems already exist (for example, at EPA for effluents, at the Corps of Engineers for Section 10 permits).

OPTIONS ANALYSIS: FEDERAL AGENCIES CONSIDERED AS CANDIDATES FOR LEAD AGENCY

Currently, several different federal agencies have statutory authorities for aspects of aquaculture operations in federal waters and/or closely related areas of expertise that could be applied to the development of a new offshore aquaculture industry for the United States. Each one of these may be considered a candidate for becoming the lead agency for an offshore aquaculture program. They include:

- *U.S. Department of Agriculture (USDA)*—USDA is the lead Federal agency with respect to the coordination and dissemination of national aquaculture information under the National Aquaculture Act of 1980, as amended, which designated the Secretary of Agriculture as the permanent chair of the coordinating group known as the Joint Subcommittee on Aquaculture. This subcommittee currently functions under the Committee on Science of the National Science and Technology Center. USDA is responsible for coordinating aquaculture initiatives of national scope through this interagency coordinating body in consultation and partnership with other key federal agencies, including NOAA, for issues associated with marine aquaculture. USDA also has numerous programs and services in multiple agencies that support marine aquaculture including research, extension, higher and pre-college education, aquatic animal health, crop insurance and disaster assistance, international trade assistance, conservation practices, and more, similar to many services traditionally extended to livestock and crop producers. USDA administers the Regional Aquaculture Center program that engages industry representatives to identify critical needs that can be more effectively

addressed by multi-state, integrated research and extension projects. Additionally, some USDA national aquaculture research centers have primary missions in marine aquaculture. Some coastal states have transferred state regulatory and assistance programs to state departments of agriculture to be regulated more similarly to agriculture.

- *U.S. Department of the Interior* – The Minerals Management Service (MMS) runs the only federal leasing programs in offshore waters of the United States for offshore oil and gas resources and has extensive experience in dealing with user conflicts in public waters. The Energy Policy Act of 2005 (H.R. 6) gives MMS authority to lease energy-related facilities for “marine-related purposes.” The U.S. Geological Survey provides mapping and other services that are critical elements in the planning process for offshore aquaculture development. The Fish and Wildlife Service has fisheries expertise and regulates interstate movement of live aquatic animals.
- *U.S. Department of Commerce* – The National Oceanic and Atmospheric Administration (NOAA) has statutory responsibilities for managing ocean resources. Within NOAA, the National Marine Fisheries Service has scientific and management expertise in marine ecosystems, including fisheries, marine mammals, threatened and endangered species, and habitats; the National Ocean Service has expertise in managing various uses of the oceans, including mapping, planning, establishment and management of marine protected areas, and dealing with conflicts in public waters; the Office of Oceanic and At-

mospheric Research has provided funding for a range of studies addressing the scientific, technical, economic, and social feasibility of offshore aquaculture and has aquaculture experts in Sea Grant extension, education and outreach programs in coastal states.

- *Department of Defense* – The U.S. Army Corps of Engineers has a permitting process in place for offshore aquaculture under the Rivers and Harbors Act of 1899. Most offshore aquaculture projects involve the placement of structures in navigable waters, which triggers the need for a Section 10 permit. Although the offshore aquaculture industry in U.S. federal waters is just getting underway, this permit is already recognized as critical for most types of aquaculture in open waters. The Corps has been involved in several regional initiatives to streamline permitting for aquaculture facilities, and has served as the lead agency in coordinating National Environmental Policy Act (NEPA) reviews for off-

shore aquaculture.

- *Environmental Protection Agency* – EPA regulates discharges from offshore aquaculture under the Clean Water Act, and has issued national effluent limitation guidelines for several production system types, including net pens in marine environments. The agency also approves the use of pesticides and chemicals used in aquaculture operations.
- *Food and Drug Administration* – FDA regulates seafood safety, approves aquatic animal drugs for use in aquaculture, and has asserted jurisdiction over the approval of genetically modified fish intended for human consumption.
- *Coast Guard* – The Coast Guard has responsibility for delineating navigational hazards, such as aquaculture structures placed in navigable waters.

PREFERRED OPTION: A NEW NOAA OFFICE OF OFFSHORE AQUACULTURE

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Recommendation 2.1

The National Oceanic and Atmospheric Administration (NOAA) is the preferred option for the location of a lead program office for offshore aquaculture

Rationale for selection of NOAA as the lead agency

Because of its statutory authorities in federal waters as well as its extensive expertise and organizational knowledge of the marine sciences and associated public policy issues, NOAA is preferred over the Minerals Management Service (MMS), the agency within the Department of the Interior. Although the MMS has extensive offshore management experience, until very recently, its mandate has essentially been single-pur-

pose—to expedite the development of the nation’s offshore oil and gas resources. This mandate has been enlarged, through the Energy Policy Act of 2005 (H.R. 6) to also include sources of renewable energy, such as wind, wave, current, and solar energy. Section 388 of the Energy Policy Act of 2005 gives the MMS authority to grant leases for activities that “use, for energy-related purposes or for other authorized marine-related purposes, facilities currently or previously used under this Act” and could allow MMS to lease offshore energy facilities for aquaculture. If and when MMS prepares and grants such leases, we would urge close coordination with NOAA.

Although USDA has expertise in aquaculture, the agency is not preferred as the lead agency for offshore aquaculture because of the significant differences between operating aquaculture facilities onshore on privately-owned property versus offshore in public waters with multiple other users. Both the Army Corps of Engineers and the Environmental Protection Agency are primarily regulatory agencies, and therefore are not

ADMINISTRATIVE RESPONSIBILITY

considered the appropriate place for a new industry development program. By placing the NOAA Office of Offshore Aquaculture in charge of the environmental review and monitoring of aquaculture by virtue of its lead role in operating the leasing program for federal waters, it is believed that concerns about insufficient oversight of environmental impacts will be alleviated.

***Rationale for the creation
of a new office within NOAA***

Management of an offshore aquaculture program involves a range of considerations (for example, siting, analysis of impacts on marine ecosystems, etc.) that cut across the existing line office responsibilities within NOAA today. Although the National Ocean Service and the National Marine Fisheries Service have expertise that is especially relevant to the management of offshore aquaculture, neither of these line offices alone (or others within the existing NOAA organization) has the range of expertise that the lead agency for offshore aquaculture will need in order to be fully effective. Furthermore, each line office also has responsibilities that will at times put it at odds with the offshore aquaculture mission, creating internal tensions that may be difficult to manage within a single line office (for example, aquaculture vs. management of marine protected areas, or aquaculture vs. commercial fishing interests).

NOAA has acknowledged these considerations, first by emphasizing a cross-line office approach led by a NOAA Aquaculture Coordinator and a team of aquaculture leads within the National Ocean Service (NOS), NMFS, the National Environmental Satellite, Data, and Information Service (NESDIS), the Office of Oceanic and Atmospheric Research (OAR), and the Office of Education and Sustainable Development, and more recently by formalizing these arrangements with the establishment of an Aquaculture Matrix Program within NOAA.

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Recommendation 2.2

It is recommended that a new Office of Offshore Aquaculture (OOA) be created within NOAA. The NOAA Office of Offshore

Aquaculture should report directly to the NOAA Administrator and be given the organizational authority to deal with inter-line office issues in implementing the offshore aquaculture program

***Responsibilities of the Office
of Offshore Aquaculture***

The new Office of Offshore Aquaculture will focus on filling the gaps in the current administrative framework rather than on absorbing functions already performed well by NOAA line offices and other federal agencies. Its primary responsibilities, therefore, will be in two areas for which no line office currently has responsibility: 1) planning for aquaculture development in federal waters and 2) establishing and operating, through the rulemaking process, an aquaculture leasing system in federal waters.

The range of activities to be performed by NOAA's Office of Offshore Aquaculture is shown in Table 2.1.

In fulfilling these responsibilities, it will be important for the Office to cultivate and maintain a good working relationship with the Army Corps of Engineers on permit-related issues, with NOAA line offices which will provide critical input to the successful operation of the offshore aquaculture program, with the Joint Subcommittee on Aquaculture, and with other federal agencies that have responsibilities in federal waters. In particular, the Office will benefit from the experience of the Minerals Management Service in conducting the minerals leasing program in federal waters, and of the EPA in establishing water quality standards and effluent limitations guidelines for aquaculture.

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Recommendation 2.3

The NOAA Office of Offshore Aquaculture should consult and collaborate with the Joint Subcommittee on Aquaculture where

Table 2.1 Organizational Responsibility for Planning, Leasing and Permitting

Implementing Actions	NOAA Office of Offshore Aquaculture		Permitting Agencies
	Planning	Leasing	Permitting
Primary point of contact on planning - provide information on proposals, status, etc.	X		
Base maps of potential aquaculture sites (existing uses, currents, depths, etc.)	X		
Designation of approved uses/areas	X		
Designation of prohibited uses/closed areas	X		
Request specialized maps for aquaculture		X	X
Prepare custom maps for aquaculture	X		
Primary point of contact on leasing - information on application, status, etc.		X	
Develop criteria and standards for leases		X	
Develop/implement system for awarding leases (including hearings, environmental assessments, interagency reviews, etc.)		X	
Establish lease terms and conditions, including fee schedules		X	
Monitor compliance and enforce lease terms and conditions		X	
Collect rents		X	
Enforce abandonment (including arranging for mitigation if necessary)		X	
Primary point of contact on permitting - information on applications, status, etc.			X
Maintain up-to-date list of criteria and standards for permits (from various agencies at federal and state level)		X	X
Develop universal lease/permit application and instructions for use		X	X
Develop/implement system for issuing permits (including hearings)			X
Initiate changes in regulations or propose new regulations			X
Develop/maintain up-to-date informational material on process and requirements (for applicants and other stakeholders)	X	X	X
Hold hearings, as necessary	X	X	X
Publish notices in Federal Register	X	X	X

Source: Prepared by research team

appropriate, for example, regarding research priorities and regulatory review.

Related responsibilities will include the establishment of appropriate standards and criteria for siting of offshore aquaculture, the preparation of environmental assessments, and the conducting of public hearings, meetings, or outreach activities as appropriate. Specific activities of the Office will include:

- Determining areas of the ocean suitable for aquaculture, through planning and mapping activities as well as through environmental review on a case-by-case basis in response to the nomination of specific sites by lease applicants;
- Providing information and guidance on the lease application process;
- Scheduling and conducting public hearings; and
- Assessing the merits of individual lease applications and awarding leases with appropriate conditions to companies that meet the leasing criteria. The process will include preparing an Environmental Assessment, conducting public hearings, and holding consultations with other agencies.

Public input and/or dissemination of information to stakeholders and the public will be an ongoing activity for the Office of Offshore Aquaculture, from the initial planning/zoning process for the designation of offshore aquaculture areas, through the joint leasing/permitting process for specific project proposals, and continuing throughout the operation of offshore aquaculture facilities, when relevant announcements (for example, important findings from monitoring of operations, penalties for violations of lease or permit conditions, or abandonment of an offshore aquaculture operation) will be made. Some of these public information activities will involve the publication of announcements in the *Federal Register*.

The Office of Offshore Aquaculture should include a business or ombudsman's section to serve as a one-stop location for the submission and processing of the joint/lease permit application form (and other requisite

materials). An ombudsman's section could serve as the primary point of contact not only for companies interested in investing in offshore aquaculture, but also for anyone who may be interested in the status of the offshore aquaculture industry (NGOs, Congress, the general public). In response to such inquiries, the section will provide general information on the type of proposals likely to receive approval, on the process for obtaining approval, and on the specific criteria and standards for particular projects. This section would also produce periodic reports on the overall status of offshore aquaculture and the major issues associated with the offshore aquaculture leasing program.

Staffing requirements

Assuming sufficient industry activity, the Office will require a mix of management, supervisory, administrative, and clerical personnel with a multidisciplinary mix of skills and experience (including planning, science, engineering, law, business, public relations, customer service, marine policy, resource management, etc.). The number of positions will ultimately depend on the degree of interest in aquaculture leasing, but the office would initially need a minimum of 15-20 people, including: a director, a deputy director, several planning professionals, program specialists/managers, financial analysts, and administrative personnel, along with, but not limited to, support in the areas of public affairs, customer service, data analysis, mapping, and clerical support. Table 2.2 provides a representative example of how the Office could eventually be organized and staffed once it is fully operational (assuming sufficient industry activity to justify program level).

Relationship to NOAA line offices and other federal agencies

The new Office of Offshore Aquaculture would enter into agreements with other offices and agencies (federal, state, or tribal), as appropriate, in order to avoid duplication of effort, make effective use of the wealth of knowledge and expertise within the other organizations, and achieve economies of scale. Within NOAA, for example:

- The Coastal Services Center of the NOS produces GIS characterizations that will be particularly useful in mapping areas of fed-

Table 2.2. Sample Organization and Staffing of Office of Offshore Aquaculture within NOAA

OFFICE OF OFFSHORE AQUACULTURE MISSION: Develop/manage the U.S. Offshore Aquaculture Program, Reports directly to the NOAA Administrator				
OFFICE OF THE DIRECTOR				
RESPONSIBILITIES: Leadership/coordination in policy, planning, programming and budgeting, oversee implementation and evaluation; ombudsman section STAFFING: Director, Deputy Director, Professional and administrative support staff EXPERTISE: Legal/regulatory analysis; policy/program planning and analysis; budget, management, and financial analysis; public and intergovernmental affairs; industrial relations				
PLANNING DIVISION	LEASING DIVISION	ENVIRONMENTAL REVIEW DIVISION	MONITORING DIVISION	ENFORCEMENT DIVISION
OFFICE RESPONSIBILITIES				
<ol style="list-style-type: none"> Develop planning and management strategies Develop mechanisms for placement of operations Compile (e.g. through requisitions) comprehensive mapping of offshore areas Identify areas suitable for offshore aquaculture Develop detailed, map-based marine zoning plans Coordinate plan development/ review, including public hearings Research and Development 	<ol style="list-style-type: none"> Develop and implement the joint leasing and permitting program for offshore aquaculture Coordinate the application review process with permitting authorities Provide recommendations on leasing decisions in response to applications. Issue and keep track of leases 	<ol style="list-style-type: none"> Conduct and coordinate environmental assessments and associated public hearings, as appropriate, in each stage of aquaculture development (planning/assessment, leasing/permitting, and long-term monitoring). Provide recommendations to permitting and leasing authorities based on environmental review process 	<ol style="list-style-type: none"> Establish and implement MOUs/MOAs with appropriate state and federal agencies to coordinate collection of data on operations of the offshore marine aquaculture industry Analyze monitoring data and appropriate follow-up recommendations to ensure operations do not exceed carrying capacity of the environment. 	<ol style="list-style-type: none"> Ensure compliance with terms and conditions of offshore aquaculture permits and leases Recommend/impose appropriate penalties for violations
Each Division would have a Director, Deputy Director, and an appropriate mix of professional and administrative support staff				
REQUIRED SKILLS/EXPERTISE OF PROFESSIONAL STAFF				
<ul style="list-style-type: none"> Cartography GIS Planning Socioeconomic analysis Environmental analysis Public affairs 	<ul style="list-style-type: none"> Legal and regulatory analysis Business and finance Program management Industry relations Aquaculture industry operations Public and intergovernmental affairs Environmental assessment and mitigation Fisheries management Aquaculture-related sciences and engineering Public and intergovernmental affairs 	<ul style="list-style-type: none"> Environmental analysis and management Risk analysis Ecology, Ecosystem management Public and intergovernmental affairs Aquaculture operations Science and engineering Fisheries and natural resource management Ocean and coastal policy and management Socioeconomic impact analysis Data collection and analysis Information management 	<ul style="list-style-type: none"> Data collection, management, and analysis Environmental analysis and management Risk analysis 	<ul style="list-style-type: none"> Environmental analysis/management Risk analysis Public and intergovernmental affairs Aquaculture industry operations Voluntary codes of conduct and practice Law enforcement Ecosystem management Ecology Industry relations

ADMINISTRATIVE RESPONSIBILITY

eral waters and determining appropriate sites for aquaculture.

- NOS, through the Coastal Zone Management Program, has ongoing relations with coastal states and can provide a bridge between federal planners in the Office of Offshore Aquaculture and state coastal planners.
- NMFS laboratories conduct scientific research on candidate species and systems for offshore aquaculture; they also have expertise in conducting risk assessments and in establishing protocols, criteria, and standards.
- NMFS has enforcement authority and capabilities for fisheries in federal waters, which can be applied in enforcing offshore aquaculture lease and permit conditions. Fishery Management Councils' efforts to regulate offshore aquaculture by amendments to fishery management plans should and likely will be superceded by a more comprehensive management structure for offshore aquaculture.
- OAR has access to external scientific expertise that can be used in answering critical questions related to offshore aquaculture and its impacts.

Outside organizations may also provide a range of technical support services in the areas of baseline surveys, monitoring, special studies, research, enforcement, etc.

The Office of Offshore Aquaculture will need to develop a good working relationship with the Army Corps of Engineers and EPA in order to coordinate the leasing and permitting process. MOUs, MOAs, or similar agreements could facilitate coordination by: detailing the respective roles and responsibilities for both agencies; providing a mechanism for regular communications between the two agencies; and establishing critical timelines for the decision process.

The major authorities of other permitting agencies are listed in Table 2.3. Although these regulations are often complex and unclear as to how they apply to aquaculture (for example, fishery management plans that place restrictions on the possession of certain species by size, season, number, etc.), individual agencies

have begun to assess their regulatory approaches to aquaculture in an effort to clarify regulations. Furthermore, in working with the NOAA office, these agencies will be encouraged to accelerate the clarification of how existing laws apply to aquaculture in order to develop a multi-purpose lease/permit application for aquaculture in federal waters.

Each federal agency with permitting authority for aquaculture, or aspects of an aquaculture operation in federal waters, will specify what information is needed to make a permit decision. Furthermore, each agency will work with the NOAA Office of Offshore Aquaculture in agreeing on a set of application questions that adequately address their information needs. Agencies may need to amend applicable regulations to accommodate the changes.

Permitting agencies will participate in the coordinated review process and, when appropriate, hold public hearings. Decisions to approve a permit (including requiring certain conditions or modification) or to disapprove a permit application will be determined according to each individual agency's criteria.

Each federal agency with permitting authority in federal waters will need to designate an aquaculture coordinator or primary contact at the headquarters level to participate in the development of the joint lease/permit application and coordinated review process. Depending on the number of applications and the complexity of the agency issues relating to issued permits, the permitting process itself may require a full-time coordinator, with additional coordinators and support staff in some regions. In the short term, however, the number of aquaculture applications may be low and the workload may not increase significantly. In such a case, additional resources beyond an agency coordinator or primary contact may not be required.

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Recommendation 2.4

Federal agencies should negotiate Memoranda of Understanding/Agreement (MOUs/MOAs) or other agreements to set out the responsibilities, authorities, and procedures of all of the agencies involved in enforcing the offshore aquaculture provisions described in this document.

Table 2.3 Possible* Statutory Authorities Applying to Offshore Aquaculture, by Agency

Agency	Statute	Citation	Description
Animal and Plant Health Inspection Service (APHIS)		21 U.S.C. 111 <i>et seq.</i>	Enforces regulations on the spread of contagious, infectious, or communicable disease of animals from a foreign country or between U.S. states.
Army Corps of Engineers (ACOE)	Marine Protection, Research and Sanctuaries Act	16 U.S.C. 1431 <i>et seq.</i>	Requires a permit for the transportation of dredged materials for purposes of dumping it into ocean waters (Section 103)
	National Environmental Policy Act	42 U.S.C. 4332	Requires a determination on environmental impacts prior to issuance of permit
	Rivers and Harbors Act	33 U.S.C. 403	Requires a permit for activities in or affecting the navigable waters of the United States, including installations and other devices permanently or temporarily attached to the seabed, erected for the purpose of exploring for, developing or producing resources from the outer continental shelf (Section 10)
Coast Guard (USCG)		14 U.S.C. 83 <i>et seq.</i>	Requires aquaculture-related structures located in navigable waters to be marked with lights and signals
	Merchant Marine Act	46 U.S.C. 12101 <i>et seq.</i>	Requires certification for vessels (including barges) of 5 or more net tons
Environmental Protection Agency (EPA)	Clean Water Act	33 U.S.C. 1251 <i>et seq.</i>	Requires a National Pollutant Discharge Elimination System (NPDES) permit prior to certain discharges (Section 402) - EPA has determined that it has authority to set ocean disposal criteria and review environmental effects of aquaculture projects under Section 403(c) - National effluent limitation guidelines issued in 2004
	Marine Protection, Research and Sanctuaries Act	33 U.S.C. 1401-1445	May require an Ocean Discharge Permit
	National Environmental Policy Act	42 U.S.C. 4332	Requires a determination on environmental impacts prior to issuance of permit
Fish and Wildlife Service (FWS)	Endangered Species Act	16 U.S.C. 1531 <i>et seq.</i>	Consultations and review of aquaculture siting permits to assure that no conflicts arise with any ongoing species recovery programs under ESA
	Lacey Act	16 U.S.C. 3371-3378	Prohibits commerce in wildlife taken in violation of state, tribal, federal, or foreign government law Prohibits the introduction of injurious species of wildlife into the United States
Food and Drug Administration (FDA)	Federal Food, Drug, and Cosmetics Act	21 U.S.C. 301 <i>et seq.</i>	Ensures that seafood shipped or received in interstate commerce is “safe, wholesome, and not misbranded or deceptively packaged.” Approval of animal drugs and feeds. GMOs
	Public Health Service Act	42 U.S.C. 262, 294 <i>et seq.</i>	Control the spread of communicable diseases from one State, territory, or possession to another
Minerals Management Service (MMS)	Outer Continental Shelf Lands Act	43 U.S.C. 1331-1356	Leasing program for the exploration, development, and production of mineral resources on the Outer Continental Shelf. Covers collection of royalties, oversight of environmental/health impacts, abandonment/removal of platforms, and per Energy Policy Act of 2005, the use of offshore energy facilities for “other authorized marine related purposes.”
National Marine Fisheries Service (NMFS)	Endangered Species Act	16 U.S.C. 1531 <i>et seq.</i>	Consultations and review of aquaculture siting permits to assure that no conflicts arise with any ongoing species recovery programs under ESA
	Magnuson-Stevens Fishery Conservation and Management Act	16 U.S.C. 1801-1882	Management of commercial fishing operations Protection of essential fish habitat Requires compliance with fishery management plans developed by regional fishery management councils (plans may be amended to accommodate aquaculture activities)
	Marine Mammal Protection Act	16 U.S.C. 1361-1421	Review and approve any facility whose operation may endanger critical habitat of marine mammals or migratory paths for whales, or otherwise result in the taking of protected marine mammals
Office of Ocean and Coastal Resource Management (OCRM)	Coastal Zone Management Act	16 U.S.C. 1451-1464	Issues guidelines and assists states with aquaculture components of state coastal zone management plans. Requires consistency certification with application for the federal permits State coastal zone management agency must certify that federal permits are consistent with state coastal zone management plan

* Includes both explicit statutory authority and agency interpretation of general statutory authority; may not apply to offshore marine aquaculture.
Source: Prepared by Susan Bunsick, Center for the Study of Marine Policy, University of Delaware, 2000.

NEED FOR LEGAL CLARIFICATION OF JURISDICTION OVER ENFORCEMENT

The following jurisdictional issues are subject to legal interpretation. Therefore, a memorandum of understanding may not provide sufficient legal weight. In that case, an alternative approach is to amend applicable authorizing legislation to specifically address offshore aquaculture enforcement.

NOAA Enforcement under the Magnuson-Stevens Act

NOAA has maintained that the Magnuson-Stevens Act gives it regulatory authority over aquaculture activities in federal waters. Section 1861(a) gives the Secretary of Commerce and the Secretary of Homeland Security authority to enforce the provisions of the Act. These two members of the Cabinet are authorized to enter into agreements with any other Federal, State or Tribal authority to use the resources of other entities for enforcement purposes.

Currently, NMFS (with assistance from the Coast Guard) enforces fishing regulations in federal waters. With respect to offshore aquaculture, NMFS would regulate concerns such as whether the aquaculture facilities are handling regulated species without permit authorization, or the impacts of the aquaculture operation on wild capture species, marine mammals, endangered or threatened species, essential fish habitat, and submerged aquatic vegetation.

NOAA v. Corps Jurisdiction

The Outer Continental Shelf Lands Act may affect discussion of whether cages, barges, floats or other such equipment are considered “structures” (subject to Corps jurisdiction on the Outer Continental Shelf) or “vessels” (giving such authority to NMFS under Magnuson-Stevens). Article 60 of the OCSLA provides the coastal state with authority to regulate such “structures” but other provisions of federal law may apply

Corps v. Coast Guard Enforcement

A question that may need to be addressed in future legislation is whether the Corps, which will analyze structural and engineering aspects of offshore aquaculture permit applications, should be involved in enforcing how facilities are actually deployed and maintained. This responsibility might more appropriately be carried out by the Coast Guard.

EPA Enforcement Under the Clean Water Act

Clean Water Act permit requirements for aquaculture facilities are enforced by the EPA. While the EPA may delegate those authorities to states for state waters or conceivably to a NOAA Office of Offshore Aquaculture, it may be reluctant to allow any other agency to enforce those authorities. The FBI as well as EPA’s Criminal Enforcement Division can get involved with criminal enforcement of the Clean Water Act.

THE ADMINISTRATIVE FRAMEWORK AS A MODEL FOR GOVERNING ALL ACTIVITIES IN FEDERAL WATERS

The administrative framework described in this chapter could conceivably be expanded into a framework for governing all types of activities in U.S. federal waters. Although many additional details of such an organization remain to be worked out, it is easy to envision how the NOAA Office of Offshore Aquaculture could eventually be subsumed into an overall agency for governing federal waters. The administrative framework for offshore aquaculture could serve as a model for establishing administrative systems to address the full range of issues and ocean activities that would fall un-

der the purview of a lead agency for federal waters. It is conceivable that the lead federal waters agency would be an Office of EEZ Planning and Management within NOAA, which could be created by expanding and renaming the NOAA Office of Offshore Aquaculture and by broadening its responsibilities; however, a strong case also could be made for alternative arrangements, such as merging the aquaculture leasing program with the Minerals Management Service leasing program within the Department of the Interior.

SUMMARY OF ADMINISTRATIVE FRAMEWORK RECOMMENDATIONS

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Recommendation 2.1

The National Oceanic and Atmospheric Administration (NOAA) is the preferred option for the location of a lead program office for offshore aquaculture.

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Recommendation 2.2

It is recommended that a new Office of Offshore Aquaculture (OOA) be created within NOAA. The NOAA Office of Offshore Aquaculture should report directly to the NOAA Administrator and be given the organizational authority to deal with inter-line office issues in implementing the offshore aquaculture program.

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Recommendation 2.3

The NOAA Office of Offshore Aquaculture should consult and collaborate with the Joint Subcommittee on Aquaculture where appropriate, for example, regarding research priorities and regulatory review.

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Recommendation 2.4

Federal agencies should negotiate Memoranda of Understanding/Agreement (MOUs/MOAs) or other agreements to set out the responsibilities, authorities, and procedures of all of the agencies involved in enforcing the offshore aquaculture provisions described in this document.

CHAPTER

3
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LEASING AND PERMITTING FOR OFFSHORE AQUACULTURE

CURRENT OFFSHORE AQUACULTURE PERMITTING LAWS AND REGULATIONS

As presently constituted, federal offshore aquaculture leasing and permitting is governed by an ill-defined framework that regulatory agencies have patched together from a hodge-podge of laws and regulations that only tangentially address aquaculture. As a consequence, the present leasing and permitting framework offers neither predictability nor efficiency. Aquaculture entrepreneurs are likely to find a walk through this imprecise thicket arduous and time consuming as they and regulators attempt to ensure that all appropriate federal and state agencies are consulted and all necessary approvals obtained. The lack of precision translates into a loss of economic development potential of U.S. federal waters. The presently vague framework further results in an increased potential for resource user conflicts as well as an inability to fully effectuate the trust responsibility that society has placed on government to promote intergenerational equity and to manage ocean and coastal resources in a sustainable manner.

The principal authorities that may bear on leasing and permitting decisions for offshore aquaculture are:

Federal Permitting Requirements (A)

- Section 10 of the Rivers and Harbors Act (RHA), 33 U.S.C. § 403
- Section 402 of the Clean Water Act (CWA), 33

U.S.C. § 1342

- Section 102 of the Marine Protection, Research and Sanctuaries Act (MPRSA), 33 U.S.C. § 1412

Environmental Evaluation (B)

- National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321-4347

Wildlife and Natural Resource Coordination and Protection Laws (C)

- Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661-666c
- Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. §§ 1851 et seq.
- Endangered Species Act (ESA), 16 U.S.C. §§ 1531 et seq.
- Marine Mammal Protection Act (MMPA), 16 U.S.C. §§ 1361 et seq.
- The Migratory Bird Treaty Act, 16 USC §§ 703-712
- Section 307(c) of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456
- National Historic Preservation Act (NHPA), 16 U.S.C. § 470

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Compatibility with Other Ocean Uses (examples) (D)

- Marine Sanctuaries: Section 302 of the Marine Protection, Research and Sanctuaries Act, 16 U.S.C. § 1432
- Scientific Uses
- Commercial Fishing
- Recreational Fishing
- Artificial Reefs: National Fishing Enhancement Act of 1984 (Corps permits for artificial reefs)
- Navigation
- National Security
- Energy Production
 - o FERC:
 - Federal Power Act (FPA), 16 U.S.C. §§ 797(e) (licenses for power development, utilization, and transmission)
 - Natural Gas Act (NGA), 15 U.S.C. 717(b)

(transportation thereof)

- o MMS: Outer Continental Shelf Lands Act (OCSLA), 43 U.S.C. 1337 § et seq. (oil and gas leasing) (Recently amended by Energy Policy Act of 2005)
- o NOAA: Ocean Thermal Energy Conversion Act (OTECA), 42 U.S.C. §§ 9101 et seq. (thermal energy permitting)

The federal permitting requirements (A) and wildlife and natural resource coordination and protection laws (C) are described in more detail below in the context of a new, joint permitting processing scheme that enhances interagency review and coordination. The environmental evaluation (B) is addressed in Chapter 5. However, given the close relationship among leasing, permitting, and environmental evaluation, some discussion of the environmental evaluation follows here as well. One of the initial considerations in establishing the institutional framework for offshore aquaculture is whether to administer the leasing and permitting processes jointly or sequentially.

PHASING OF THE LEASING AND PERMITTING PROCESSES

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Recommendation 3.1

It is proposed that leasing and permitting proceed jointly given the time and efficiency gains that are expected from joint leasing and permitting without any loss of environmental protection.

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Recommendation 3.2

In light of the fact that joint leasing and permitting will require close coordination, the authors recommend that a formal mechanism be established to enable NOAA, the Army Corps of Engineers, and

other interested federal agencies to cooperate with one another and to coordinate their respective reviews.

Joint Lease/Permit Application Process

A joint lease/permit application should be devised that will require the submission of information (in conjunction with the NEPA review) that is sufficient to allow a determination of whether or not to issue a lease, a Section 10 RHA permit, a Section 402 NPDES Permit, and a CZMA consistency determination. The Office of Offshore Aquaculture will make lease decisions and operational stipulations, and also facilitate review by relevant permitting agencies. State permits may or may not be required. For example, some states may require a permit to transport live fish through state jurisdictional waters. Regardless of whether or not state permits are

required, the application should have sufficient information to allow affected states to make a consistency determination under the CZMA.

For example, the northeast region of the NOAA National Marine Fisheries Service developed a detailed “scoping outline” (NMFS 1998) for use by prospective offshore aquaculture applicants in the northeastern section of the United States. The document requires from applicants a detailed description of the:

1. Proposed activity;
2. Environmental setting (land and water-based);
3. Significant non-aquatic environmental and social impacts;
4. Significant aquatic and non-aquatic environmental impacts that can be mitigated;
5. Adverse environmental impacts that cannot be avoided or mitigated should the project be implemented;
6. Alternatives that are available to achieve project success; and
7. Value to the community.

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Recommendation 3.3

A joint, multi-purpose lease/permit application form to guide review by all appropriate federal and state agencies and the public, should be developed for use by all applicants seeking to locate aquaculture facilities in federal waters.

At a minimum, the joint application form should contain the following information:

- The name, address, telephone, fax, and email address of the applicant and the applicant’s agent;
- Project name or title;
- A brief description of the proposed activity, its purpose and intended use; and

- A list of any certifications, permits or permissions already applied for, including date applied, date approved or denied, administering agency, and identification number;

Rationale Behind Phasing of the Leasing and Permitting Processes

As stated above, this report recommends a joint leasing and permitting process. Discussions between the authors revolved around two possibilities, the chosen joint process and a second option of leasing first and permitting second. The next two sections further explore the pros and cons of each.

Option 1: Joint Leasing and Permitting Process (Chosen)

The first option is to administer the offshore aquaculture leasing and permitting jointly- essentially the process followed by the State of Hawaii. This method has the advantage of protecting public rights and ensuring that the rights to ocean space are not dedicated to private use prior to the time that a private party has obtained all necessary permits and approvals. A joint process also may be attractive to the extent that the leasing and permitting are overseen by different agencies and it is desired that a resource management agency, such as NOAA, take the lead on reviewing the project-specific environmental impacts in the context of the leasing decision rather than, for example, the Army Corps in the context of permitting. In such a circumstance, the permitting agency would nonetheless rely on NOAA’s environmental evaluation when making its permitting decision. Because leasing and permitting would be undertaken jointly, *only one single site-specific environmental evaluation would be required.*

The federal government would not resolve compatibility of aquaculture at a given location with other potential ocean uses (for example, a marine sanctuary or an oil and gas leasing site) prior to the point in time when the aquaculturalist has to invest in a project-specific environmental evaluation (and which would otherwise occur at the permit stage). This approach raises some concerns from the perspective of members of

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the aquaculture industry as they would not secure property rights to publicly-controlled bottomlands and ocean space before the initial investment for an environmental evaluation. Although the joint approach would expose aquaculturalists to somewhat greater financial risk, as well as the risk of being outbid on the lease, mechanisms can be employed to allay those concerns. In Hawaii, for example, in the event the permit applicant is outbid, the winning bidder is required to reimburse the permit applicant for its costs.

There is an additional layer that may precede leasing; initially, the federal government might zone public, private, or joint venture “aquaculture parks.” Under this scenario, the environmental implications of dedicating a wider swath of ocean would be evaluated prior to any decision to lease a particular tract within the park or to issue a permit to conduct aquaculture operations. After obtaining approval for such a park, the operator could sublease the park in segments at which aquaculture operations could take place, provided appropriate permits are obtained. Publicly-managed aquaculture parks may have the advantage of protecting the public’s rights to ocean resources while at the same time providing aquaculturalists with greater certainty that ultimately they will be able to secure the property rights in question. Chapter 4 addresses this and other site determination options in more detail.

Option 2: Leasing First, Permitting Second (not selected)

An applicant could obtain a lease from NOAA and only later, in the context of a specific proposal, seek any necessary permits. This model is based on the process followed by the Minerals Management Service (MMS) for offshore oil and gas leasing under the OCSLA. From the perspective of the aquaculture industry, it secures property rights early in the process, yet it is problematic from the public’s perspective in that it gives applicants private rights to public resources before they have secured necessary permits.

Under a lease first-permit second scenario, NOAA should have addressed compatibility at the leasing stage, and thus it is envisioned that these issues would not be prominent during permitting. Nevertheless, the lead permitting agency as described below, would be required to notify agencies that regulate other ocean uses (such as MMS, the regional fishery management councils, and state fish and wildlife agencies) of the permit application and provide those agencies with an opportunity to review and comment on the permit application. To the extent that a lease does not limit aquaculture activities to specific species, an analysis of the impacts of the proposed species-specific aquaculture activity on commercial and recreational fishing is contemplated during the permit stage. In that event, the environmental evaluations would be tiered, with one being conducted at the leasing stage and a second, project-specific evaluation at the permit stage. This tiered approach may be disadvantageous to aquaculturalists from timing and cost perspectives and may generate conflicting conclusions to the extent that the two environmental evaluations are overseen by different federal agencies.

THE OFFSHORE AQUACULTURE OPERATIONAL BUSINESS PLAN

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Recommendation 3.4

When applying for a standard offshore aquaculture lease and associated permits, the applicant should provide detailed information on the proposed aquaculture operation in the form of an Offshore Aquaculture Operational Business Plan.

The Offshore Aquaculture Operational Business Plan should, at a minimum, include the following elements:

- A description of the location of the proposed lease by coordinates and a map of the lease area;
- A description, engineering drawings, and photos of the offshore aquaculture structure(s) to be deployed, included specifications, dimensions, operational protocols, mooring systems, etc.;

- A list of the species to be cultivated and a description of the proposed source(s) of organisms to be grown at the site;
 - The maximum stocking density, volume of production, and production schedule that is anticipated initially and at full operation;
 - Whether the facility will be a single or multiple year class operation;
 - Environmental characterization and baseline information, including:
 - Description of substrate and benthic fauna and flora;
 - An analysis of the chemical constituents of the discharge, including constituent composition and potential for bioaccumulation or persistence;
 - The volume of the effluent and concentration of the pollutants that will reach the receiving waters;
 - A description of any processes that will be employed to reduce pollutant quantities and/or concentrations;
 - An analysis of the quality of the receiving waters [with bioassays, as appropriate] necessary to determine the limiting permissible concentrations for the discharge;
 - An analysis of the current and mixing dynamics (both positive and negative effects)
 - An analysis of the potential for pollutant transport by biological, physical or chemical processes;
 - Evaluation of available alternatives to the discharge of the pollutants;
 - Measures that will be employed to monitor and prevent the escape of farmed fish;
 - A delineation of best management practices that will be followed in order to minimize pollutants;
 - An evaluation of cumulative impacts;
 - A description of the degree of or exclusive use required by the project;
 - A description of the navigational, commercial and recreational fishing, and military uses of the proposed lease site;
 - A description of any protected reserves, preserves, sanctuaries, or other protected areas within one mile of the proposed operation;
 - Sufficient financial information to establish the basis for the performance bond and to provide NOAA with sufficient assurance that the applicant has the financial resources to operate and maintain all aspects of the proposed offshore aquaculture operation, and that the lease applicant has the necessary financial resources to ensure compliance with federal and state environmental and natural resources laws. Any confidential business information will be kept confidential by NOAA in accordance with law;
 - Documentation to demonstrate the applicant's technical capabilities; and
 - A discussion of the benefits that may reasonably be expected to accrue from the project, including the economic benefits to local communities.
- In addition, the Offshore Aquaculture Operational Business Plan should include four subsidiary plans:
- A Monitoring Plan that is sufficient to assess the impact of the discharge on water, sediment, and biological quality;
 - An Emergency Response Plan in the event the aquaculture operations must be temporarily relocated;
 - An Escape Response Plan; and
 - An Abandonment/Closure Plan
- The NOAA Office of Offshore Aquaculture will determine the level of detail in the information provided to it by offshore aquaculture applicants, but the concept is that the Operational Business Plan provides sufficient information for NOAA's leasing decision and other agencies' permitting decisions. A briefer, preliminary plan may be appropriate for interim leases so as to enable an aquaculture firm to develop an Offshore Aquaculture Operational Business Plan in preparation for a long term/standard lease.
- If a government agency denies or the aquaculturalist otherwise fails to obtain a lease or any applicable permit, aquaculture operations would not be allowed to take place.

OFFSHORE AQUACULTURE LEASING PRINCIPLES

The Public Trust Doctrine holds that “navigable waters” within the boundaries of a State are held by that State in trust for the people to use and enjoy (for navigation, fishing, bathing, and similar uses). The courts have typically frowned on provision of these public rights to a private entity for private gain, but in certain cases, it is possible to dedicate a portion of trust property to private use, provided that the action is in the public interest (Rychlak 1997). Rychlak (1997) argues that fish are held in the public trust and thus, “regulations governing the artificial cultivation” of fish and shellfish fall within the scope of the Public Trust Doctrine. Whether the public trust doctrine applies to offshore waters controlled by the United States is not entirely clear; however, the principle that the public benefit from any privatization of public resources is equally applicable to the United States when it seeks to privatize the use of federal offshore waters for private gain. As such, this consideration has relevance to the establishment of a federal offshore aquaculture institutional management framework.

The federal government, in evaluating and approving offshore aquaculture operations, must address public trust-like issues. Offshore aquaculture producers must acquire the right to occupy waters (and lands in some cases) controlled by the federal government for the benefit of the people, as well as for the ability to protect their operations from trespass, theft, vandalism, and competing uses. In other words, they must secure a reasonable level of exclusivity for the site, within which the operation will be located. This exclusivity can be accomplished through the development and implementation of a comprehensive leasing system for the water column and ocean bottom that protects rights of the public, offers adequate exclusivity to the operations, and serves the public interest through compensation.

Currently, no federal legal or institutional structure exists to comprehensively promote and regulate marine aquaculture in federal offshore waters of the United States. Regulatory issues requiring resolution include the “limited availability of property rights to protect the investment” of the marine aquaculture operation, the “security of ownership of fish in cages”, and the “nature of the governmental authorization received by the

operator” (Waldemar 2001). Fletcher and Neyrey (2003) pose the following set of questions that must be addressed in federal leasing statutes as they are developed:

1. What agency or agencies have leasing authority?
2. Does the lease contain limitations as to size, aggregate amount of area that may be leased, time restrictions on leases, and the number of leases that may be held by a party at one time?
3. For what purposes may leases be issued (other than aquaculture)?
4. What is the lease cost?
5. What is the penalty for using offshore waters without holding a lease?
6. What public review and comment provisions will be built into the leasing process?
7. How will the leasing process address issues related to riparian owners, navigation, fishing, and other uses; ecological carrying capacity; and use of publicly-owned facilities?
8. What are the reporting requirements for leaseholders?

The success of any aquaculture firm operating in public waters depends upon the ability of the culturist to exercise control over the site through ownership, lease, or other form of conveyance. However, for aquaculture operations requiring the use of public resources in federal offshore waters, the necessary institutional and regulatory structure to balance the needs of aquaculture with those of the users of public resources is absent. The establishment of an offshore aquaculture leasing structure, which conveys property rights to submerged lands and/or the water column, will offer some degree of exclusivity to aquaculturalists.

A leasing system must be established, which gives the firm the level of exclusivity required (of limited time duration) for initial exploration and for subsequent further development, on the basis of a preliminary plan provided by the aquaculture firm. Lease provisions must

be consistent with public trust responsibilities. Furthermore, preference should be given to firms that maintain environmental quality, avoid use conflicts, and demonstrate an approach ensuring high productivity of the operation.

There should be an expectation that private users of public waters provide fair compensation to the public in return for exclusive use of a federal offshore water site (Firestone et al. 2005).

Guiding Principles for Offshore Aquaculture Leasing

The process of awarding leases to aquaculture firms should be guided by a set of principles, such as the following as adapted from Eichenberg and Vestal (1992) for coastal states:

1. Leasing laws should integrate broad public trust criteria.
2. The United States should develop water column and sub-bottom leasing laws that are specific to marine aquaculture.
3. Submerged lands leasing programs should include criteria to establish priorities among aquaculture applicants competing for the same site.
4. Leasing laws should include criteria by which priorities can be set for non-aquaculture uses competing with aquaculture applicants for the same site.
5. Public lands leasing programs should include requirements for the agency to assess the extent to which the applicant needs exclusive use of the site, and, to the maximum extent possible, should reserve to the public the right to use the leased lands for all public trust purposes that will not unreasonably interfere with the culture of specified organisms.
6. Aquaculture leasing laws should include provisions granting lessees not only specified rights to occupy the site, but should also grant exclusive rights to ownership of the cultured species.
7. Leasing laws should contain provisions prohibiting leasing of certain lands which should remain in the public domain.

The main goals of an offshore aquaculture lease, from the perspective of the government, are to ensure the

adequate protection of the marine environment as well as the preservation of the public trust and public safety. The government has several choices as to how it achieves these goals. It can stipulate specific limits on certain practices (for example, specific feed types, rates, or stocking densities) and/or establish acceptable parameters to guide operations (such as nutrient concentrations and biological oxygen demand levels), allowing the operator to manipulate the management approach in order to stay within the desired parameters. Offshore aquaculture leases should delineate those operational parameters that will have an appreciable impact on the aforementioned goals. However, to the extent feasible and consistent with the protection of the marine environment, operational guidelines should allow the aquaculture operation to exercise its best judgment and manipulate its operations in whatever way it sees fit, as long as its operations are conducted in a manner consistent with the environmental review principles established in Chapter 4 of the Report and it is able to achieve the goals, standards, and limits established by law and/or embodied in its lease. Codes of Conduct and Best Management Practices (BMPs) should guide offshore aquaculture operations. Regulators, in consultation with industry and stakeholders, should develop such Codes and BMPs, which should be monitored and enforced by the leasing agency.

General Provisions of an Offshore Aquaculture Leasing System

An offshore leasing program should include consideration of the following elements:

- *Eligibility* – The guidance established by the government of British Columbia in Canada provides a useful example for the development of eligibility criteria in the United States. Following the British Columbia example, to be eligible to obtain a lease for an aquaculture facility, an applicant should be (a) a United States citizen or a permanent resident 18 years or over; (b) a corporation incorporated under the laws of the United States; or (c) a registered partnership. Other legal forms such as a joint venture or a trust may also be appropriate.
- *Scope* – Leasing provisions should include considerations for the “three-dimensional” use of the ocean environment by aquaculture operations: (a) the ocean floor (bottom culture), (b) the superjacent water column, and/or (c) the sea surface.

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- *Aerial coverage* – Leasing provisions should identify locations in federal offshore waters and establish guidelines (minimum and maximum) for those locations where offshore aquaculture firms could obtain leases.
- *Lease duration* – The term of the lease should provide the firm with sufficient time to plan, initiate, and establish its offshore aquaculture operation and, at the same time, provide the federal government with the flexibility to be able to reassign, suspend, or terminate leases for just cause. Criteria for such action must be established.
- *Exclusivity* – Federal offshore waters leasing programs for aquaculture should include provisions to require the federal government to assess the needs for exclusivity given the nature of the proposed project and the characteristics of the areas under consideration.
- *Compensation* – Provisions to require the lessee to pay for the (semi-) exclusive use of resources associated with the lease should be established in the aquaculture-leasing program. These payments could take the form of fees, royalties, and/or other means, and should be adequate to help pay for the costs of administering the leasing program.

Administration and Oversight of the Leasing Process

At the present time, there is neither a formal federal offshore aquaculture leasing process in place nor a designated agency responsible to administer and oversee a leasing system for offshore aquaculture.

Nevertheless, the leasing of OCS mineral resources (non-oil and gas minerals and sand) provides an excellent example of how an offshore leasing program might be structured (Giordano et al. 1999). The Minerals Management Service (MMS) of the U.S. Department of the Interior leases mineral rights in federal offshore waters through competitive lease auction. The lease is usually granted to the applicant submitting the highest bid. Any person or company may request that OCS minerals be offered for lease. The MMS then publishes what it calls a “Request for Information and Interest” (RFII) in the *Federal Register* to determine whether additional interest exists in obtaining leases for non-oil and gas minerals and sand resources and to

obtain other information that is relevant to the lease sale decision.

The MMS gathers comments, information, and indications of interest from interested parties that address:

1. Commercial, navigational, recreational, and multi-use considerations; environmental concerns, including information on biological and physical resources; archaeological resources; and social and economic issues.
2. Potential conflicts with approved state and local coastal zone management plans and steps that the MMS could take to avoid or mitigate these conflicts.
3. Indications of interest from industry respondents, specifying areas within the RFII area that are of particular interest for consideration in a possible OCS sand and gravel lease sale.

The RFII specifies a comment period. During this time, the MMS may schedule public workshops to discuss the RFII and the leasing process. Information received by the MMS is used to make a preliminary determination on whether the leasing process should continue and, if so, then the environmental assessment is conducted.

Proposed Leasing Program Framework for Offshore Aquaculture

In the proposed approach, the importance of the following items is stressed: initially determining suitable areas for aquaculture; offering these areas for joint leasing and permitting through a coordinated interagency process; making a determination of environmental effects and effects on other users through the NEPA process; and then subsequently awarding (or not) a lease and the requisite operating permits.

An offshore aquaculture leasing program must include provisions that:

- Identify a lead federal agency responsible for administering an offshore aquaculture leasing system;
- Identify, assess, and evaluate areas within the federal waters compatible (and incompatible) with

the needs of offshore aquaculture operations, resource conservation, navigation, fishing, other uses, and public access;

- Allow for input by the public and review by the states;
- Ensure, through reasonable lease terms and conditions, both the viability of offshore aquaculture operations and protection of the public interest;

- Require a detailed description of the scope, nature, and operation of any proposed offshore aquaculture operation; and
- Provide for regular monitoring of the operation, including the establishment of minimum production and performance levels, environmental compliance, utilization of best management practices, and other approaches.

PROPOSED AQUACULTURE LEASE

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Recommendation 3.5

Congress should create a new offshore aquaculture leasing authority, vest that authority with NOAA, and direct the Army Corps of Engineers to focus its Section 10 review on national security and navigation and to rely on the NOAA-coordinated environmental evaluation. Leases should spell out terms of tenure and operational parameters.

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Recommendation 3.6

The NOAA Office of Offshore Aquaculture should have the authority to grant offshore aquaculture leases for areas in, on, and under federal waters and the responsibility to administer and monitor all offshore aquaculture leasing activities.

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Recommendation 3.7

It is proposed that the NOAA Office of Offshore Aquaculture facilitate inter-agency interaction with other relevant permitting

agencies, so as to create a one-stop process for applying for offshore aquaculture leases and permits.

An Aquaculture Lease that Includes Operational Terms

Although the Army Corps issues section 10 permits in the oil and gas context, its involvement in the process is minimal. The Army Corps' minimal level of involvement in offshore oil and gas development is consistent with its policy "that state and federal regulatory programs should complement rather than duplicate one another" [33 C.F.R. 320.1(a)(5)]. Consequently, where lands "are under mineral lease from the [MMS], that agency, in cooperation with other federal agencies, fully evaluates the potential effect of the leasing program on the total environment." Accordingly, the Army Corps' decision whether to issue a permit on those lands is "limited to an evaluation of the impact ... on navigation and national security" [33 C.F.R. 322.5(f)]. In such circumstances, the Army Corps uses "general permits, joint processing procedures, interagency review, coordination, and authority transfers (where authorized by law) to reduce duplication." [33 C.F.R. 320.1(a)(5)].

This bifurcation of responsibility has worked well for the Army Corps and MMS in the oil and gas context and could be replicated in the aquaculture context. Under this scenario, Congress would create an aquaculture lease that sets forth operational parameters (for example, species, density, production volume, production schedule, feed type and rate, emergency and es-

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cape response) in addition to specifying the terms of the tenure (for example, duration, geographic extent, fees, termination) in leasing federal ocean space. From an efficiency standpoint, it makes sense to base decisions on the operational characteristics of the proposed aquaculture operations in the hands of the same agency—NOAA—that will have aquaculture leasing authority and for that agency to jointly consider lease terms and operational parameters in the context of a lease application. Moreover, in such a “joint” process only one environmental evaluation would be required. The one downside to encompassing operational parameters within the lease, is the potential for conflict of interest. However, given that fees/royalties are not likely to be substantial and that NOAA has other strong constituencies that may have interests adverse to aquaculture (for example, commercial fishers and conservation/preservationists concerned with marine mammals, endangered species, and fish habitat), there may be more of an appearance of conflict of interest than actual conflict.

It is envisioned that leases would spell out terms of the tenure (for example, coordinates, length, royalties, cancellation, performance bonds, closure), and delineate operational parameters (for example, production levels, facility design, emergency response, escape response) while the Section 10 permit would be limited to navigation and national security concerns. As the lead federal agency, NOAA would have responsibility for coordinating and consulting with other federal agencies to ensure that other concerns such as cultural resource protection are accounted for in the leasing decision. An aquaculturalist would continue to need to obtain a RHA permit from the Army Corps—but as mentioned above, that permit would be limited to national security and navigational concerns and likely would take the form of a general permit.

This sharing of responsibility makes sense given the Army Corps’ and NOAA’s respective capabilities: The Army Corps has knowledge and expertise in the areas of national security and navigation while NOAA has expertise in the areas of fisheries, marine mammal protection, ocean science and coastal management. Furthermore, NOAA has specific responsibilities under the ESA, MMPA, MSPRA, CZMA, the Magnuson-Stevens Act, and the Fish and Wildlife Coordination Act, all of which would be implicated by both a Section 10 and an aquaculture lease. Moreover, in light of the fact that NOAA will already be conducting an environmental

analysis in the context of the leasing decision, designating NOAA as the lead agency to consider the operational parameters of proposed aquaculture operations for any NEPA analysis is both cost effective and time efficient. In sum, while NOAA would take the lead on environmental matters, the Army Corps would retain its responsibilities under Section 10 for analyzing the impact of the proposed aquaculture permit on navigation and national security and would help to ensure coordination with other relevant federal and state agencies such as the Coast Guard and the Department of the Navy.

The NOAA Office of Offshore Aquaculture could eventually be incorporated as a component of a larger NOAA office responsible for managing all offshore facilities and operations. Regardless of its placement, the NOAA Office of Offshore Aquaculture would be responsible for oversight and management of the offshore aquaculture-leasing program, monitoring of offshore aquaculture facilities, and eventual abandonment of such facilities.

Option Considered but not Selected: Section 10 of the Rivers and Harbors Act Permit to Function as an Operations Permit

One option was for the Army Corps to take the lead on permitting and for the Section 10 permit to become the primary means for the federal government to permit aquaculture facilities. Section 10 of the Rivers and Harbors Act (RHA), 33 U.S.C. § 403, and implementing regulations require that any person desiring to construct a structure in or over any navigable water of the United States to first obtain a permit from the U.S. Army Corps of Engineers. When it enacted the Outer Continental Shelf Lands Act of 1953 (OCSLA), Congress extended the Army Corps’ jurisdiction to the regulation of islands, installations and other devices to the seaward limit of the outer continental shelf, 43 U.S.C. §1333. Thus, under present law, a Section 10 permit would be required of anyone who seeks authority to conduct offshore aquaculture. Substantively the Army Corps balances a number of use issues (for example, navigation, fish and wildlife, water quality, and recreational and other uses) in making a permit decision in the “public interest” (33 C.F.R. § 320.4).

Under present practices, the Army Corps may, if there is public demand, hold a public hearing on the project, 33 C.F.R. §327.4; in light of the novelty of aquaculture permitting, we recommend that it be mandatory in the event Section 10 gains primacy in aquaculture. It also should be noted that the Army Corps has the latitude to grant a temporary permit for short-term research projects (with minimal environmental evaluation) or a “full” permit requiring an Environmental Assessment (EA) or, if there is significant impact, an Environmental Impact Statement (EIS), an approach that could be termed “risk-based permitting” (*See, for example*, Bay 1993).

Planning and Siting of Offshore Aquaculture Operations

As discussed in Cicin-Sain, et al. (2001), the capacity for mapping the natural features and current and future uses of federal offshore waters (but not the explicit mandate to do so) is present at NOAA and at the U.S. Department of Interior. For this work to occur, however, these agencies would need to be given the necessary financial and personnel resources, through both administrative and new congressional action on aquaculture. It is important that this planning process take place on a timely basis; otherwise, the development of the offshore aquaculture industry will be significantly hindered. Proposals for offshore aquaculture operations, however, may need consideration by the NOAA Office of Offshore Aquaculture before or while these planning efforts are underway. If this is the case, decisions should be made on the basis of available information. A detailed discussion of planning and siting needs can be found in Chapter 4.

Offshore Aquaculture Leases

Cicin-Sain et al. (2001) argue for the establishment of a federal offshore leasing framework for aquaculture. Leases can provide aquaculture operations (semi-) exclusive rights to occupy a site and exclusive rights to the cultured species. They also can provide more protection for and delineate more responsibilities required of the aquaculture operation than can permits or licenses. Such a leasing framework should be guided by a set of principles relevant to public trust responsibilities and

should specify the scope, size, duration, and other terms of the lease. Some form of compensation to the public for the exclusive rights granted should also be incorporated into the lease terms.

The aquaculture lease regulations developed by the Maine Department of Marine Resources (13-188, Chapter 2) have been used as the basis for a portion of the recommendations put forth below.

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Recommendation 3.8

Four types of leases should be authorized:

- (1) A research lease to encourage the development and testing of new gear or techniques and to allow for scientific research;*
- (2) A short-term (or interim) lease to enable an aquaculture firm to further develop the facility's Offshore Aquaculture Operational Business Plan;*
- (3) A long-term (or standard) lease for an applicant with a fully developed Offshore Aquaculture Operational Business Plan; and*
- (4) An emergency lease to provide the culturist with a rapid response capability in the event facilities must be temporarily moved or relocated.*

Research Aquaculture Leases. The NOAA Office of Offshore Aquaculture should have the authority to grant a research offshore aquaculture lease in federal offshore waters for commercial aquaculture research and development, for scientific research, and/or for assessing commercial viability of a proposed operation. The research lease should be limited to a maximum of 50 acres and to a period of no longer than 5 years.

Short-Term Aquaculture Leases. The NOAA Office of Offshore Aquaculture should have the authority to grant short-term provisional leases to allow commercial applicants to develop an operation's project concept and test its feasibility. The short-term lease should be granted for a period of no longer than three years.

Commercial Offshore Aquaculture Leases. The NOAA Office of Offshore Aquaculture should have

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the authority to issue an offshore aquaculture lease to site and operate an offshore aquaculture operation. The offshore aquaculture lease may be granted for a period of up to ten (10) years, renewable thereafter at five-year intervals.

Emergency Aquaculture Leases. The NOAA Office of Offshore Aquaculture should have the authority to grant an emergency offshore aquaculture lease when the health and safety of the species in confinement is threatened and the NOAA Office of Offshore Aquaculture determines that the relocation of the offshore aquaculture facilities will not threaten the environmental quality of the receiving waters or the health of marine organisms in those waters. The purpose of the emergency lease is to allow for the quick relocation of offshore aquaculture facilities as the result of an unanticipated, natural, or man-made phenomenon that is beyond the control of the leaseholder.

Offshore Aquaculture Lease Terms and Conditions

Application Requirements

Form. All applications must be submitted on the joint form prescribed by the NOAA Office of Offshore Aquaculture—a form that is comprehensive enough to serve as the application for any other necessary permits, licenses, and certifications for the operation under consideration.

Fee. A nonrefundable application fee must be submitted along with the application form. The amount of the fee should be determined by the nature of the offshore aquaculture operation and the relative size of the proposed lease site.

Required Elements. In addition, the applicant must furnish detailed information in the form of an Offshore Aquaculture Operational Business Plan (taken from the aquaculture lease regulations of Maine (U.S.) and British Columbia (Canada)) as detailed earlier.

Offshore Aquaculture Lease Acreage, Siting, and Review

Aquaculture Lease Acreage. While many coastal states that have adopted aquaculture leasing guide-

lines usually set a maximum area limit for leases per applicant, the size of each offshore aquaculture lease should be negotiated based upon the amount of acreage available and the demonstrated needs and capabilities of the culturist.

Siting and Spacing of Offshore Aquaculture Operations. Leasing guidelines should be developed that address the possibility of multiple-use conflicts in the proposed ocean space. These guidelines should address marine reserves and sanctuaries, existing offshore aquaculture leases (both shellfish and finfish), wildstock shellfish beds, important cultural resources, and others as deemed necessary and appropriate.

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Recommendation 3.9

Consideration needs to be given to the cumulative impacts of offshore aquaculture facilities and, consequently, spacing and fallowing guidance should be developed by the NOAA Office of Offshore Aquaculture.

Public Interest Review. Applications for offshore aquaculture leases should be subject to public interest review. A single, coordinated review process should be developed so as to serve the needs and requirements of the offshore aquaculture lease program and the federal permitting process. A notice of lease and permit application and of public hearing should be made available to the applicant, the relevant federal agencies, the states (and the relevant agencies therein), and the public potentially affected by the proposed aquaculture operations. This notice should also be publicized in regional and local media.

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Recommendation 3.10

Adoption of a mechanism similar to the Request for Information and Interest (RFII), utilized by the Minerals Management Service in leasing sand and gravel

resources, should be incorporated into the offshore aquaculture leasing program adopted by the NOAA Office of Offshore Aquaculture. The RFI process should be enhanced by requiring the scheduling of public hearings for areas potentially affected by the proposed offshore aquaculture operation.

Environmental Assessment

As part of ensuring environmentally sound and acceptable decisions for offshore aquaculture operations, the NOAA Office of Offshore Aquaculture should prepare an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS), as appropriate, to determine possible environmental consequences of offshore aquaculture development. This environmental review process is used to assess the full range of possible impacts, offers a set of alternatives for development, and identifies mitigating measures and stipulations to such possible impacts. The NOAA Office of Offshore Aquaculture should determine the type of environmental analysis required under NEPA on a case-by-case basis. Environmental considerations are detailed in Chapter 5.

Offshore Aquaculture Lease Decision

In considering whether or not to grant an offshore aquaculture lease, the NOAA Office of Offshore Aquaculture should consider the extent to which granting the offshore aquaculture lease is consistent with criteria set forth in existing and newly created law and regulations (for example, regarding fair return to the public from the use of offshore waters, use of a precautionary approach, and the principle of sustainable use), and the extent to which the proposed operation will affect:

1. Navigation;
2. Fishing (commercial and recreational) and essential fish habitat;
3. Other aquaculture uses;
4. Ecological carrying capacity;

5. Source of organisms to be cultured;
6. Military or other federal government operations;
7. Existence of marine protected areas, marine sanctuaries, and other resource preserves;
8. Endangered, threatened, and depleted species; and
9. The public's interest in federal offshore waters.

In addition, a Coastal Zone Management Plan Consistency Determination(s) should be made, as appropriate. If certified, a Draft Leasing Notice should be published for public comment, and a Final Leasing Notice will be published thereafter. *Under no circumstances should an offshore aquaculture lease be granted if the firm fails to obtain all its licenses, necessary permits and certifications.*

Responsibilities of the Offshore Aquaculture Leaseholder and Lease Terms

General Lease Terms. The lease should specify acreage, duration, and operational parameters.

Facility Operations. The lease should provide that the aquaculture operations shall be conducted in accordance with a final, NOAA-approved Offshore Aquaculture Operational Business Plan, which should be incorporated into the lease and made an enforceable part thereof.

Lessee Rights. Any lease issued by the NOAA Office of Offshore Aquaculture should vest in the lessee: (a) the exclusive right during the term of the lease to keep, breed, hatch, and culture the species of finfish and/or shellfish within the leased area and to take the species of finfish and/or shellfish from the leased area; and (b) the ownership of all fish specified in the lease that are within the leased area (see: McMullan and Weir 1998).

Environmental Monitoring. As a condition of a lease, the NOAA Office of Offshore Aquaculture should require that environmental monitoring be conducted on standard offshore aquaculture lease sites. Environmental monitoring also will be required for research and short-term leases, albeit at scales relative to the size of the operation.

Access and Information. The lease should include a provision allowing employees and representatives of the federal government access to the lease

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site, aquaculture facility, and associated vessels to conduct monitoring, inspection and enforcement activities. Moreover, the lessor should be required to furnish, on reasonable notice, information, documents, and records that may be relevant to occupational health and safety or to the protection or preservation of the marine environment.

Health and Safety. The operator should be required to maintain all places of employment within the leased area in compliance with occupational safety and health standards and free from recognized hazards.

Annual Rental Fees. The operator should be assessed an annual, per-acre lease rental fee, and a royalty fee, as necessary and appropriate, in exchange for the semi-exclusive use of offshore space for aquaculture. The NOAA Office of Offshore Aquaculture should establish the amount of this fee(s) after due consultation with the offshore aquaculture industry, other ocean user constituencies, the public, and agencies of the federal government.

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Recommendation 3.11

In exchange for the semi-exclusive use of offshore space for aquaculture, the NOAA Office of Offshore Aquaculture should establish rental fee and royalty rates after due consultation with the offshore aquaculture industry, other ocean user constituencies, the public, and other federal agencies.

Sub-leasing and Lease Transferability. The NOAA Office of Offshore Aquaculture should not recognize any sub-leasing arrangement from leases it grants that may be entered into by the leaseholder. The original lessee should be held responsible for meeting all legal and administrative requirements and liabilities arising from the operation of the lease. These stipulations should also apply for major stockholder changes.

The NOAA Office of Offshore Aquaculture may consider approving the transfer of a lease from one lessee

to another, provided that the original lessee completes a Request for Transfer form, the proposed subsequent lessee makes an appropriate financial disclosure and otherwise satisfies all financial requirements of the lease (for example, establishment of a performance bond), and the NOAA Office of Offshore Aquaculture puts the request on official public notice, holds a public hearing, and evaluates the transfer according to the criteria outlined in its leasing provisions.

Performance Bonds

An escrow account, performance, or security bond should be required of all successful applicants for offshore aquaculture leases. These funds may be necessary for the rehabilitation of a lease area upon the transfer, expiration, or cancellation of a lease, to ensure that the lease site can be returned to its natural state in the event that the site is abandoned. The value of such a bond must be sufficient to remove and salvage, resell, or dispose of all of the anchors, cordage, cages and physical equipment on the site. To calculate this value, the NOAA Office of Offshore Aquaculture should collect bids from several independent salvors at the time of application and every five years thereafter.

The term of the policy for the Performance Bond should be such that under no circumstances should the bond be allowed to lapse prior to both a final inspection of the site and a certification by the leasing authority that the site has been cleaned up to its satisfaction. It should be the responsibility of the applicant to purchase the bond for a minimum of two years into the future and annually renew the bond.

Termination and Revocation of the Lease

Any offshore aquaculture lease may be terminated or revoked due to:

- Late or non-payment of rents/royalties;
- Failure to meet performance standards;
- Breach of lease stipulations;
- Operating outside the approved lease area; or
- Failure to obtain or maintain all required permits.

In addition, a lease may be terminated if the continued operation of the aquaculture facility may result in substantial harm or damage to life, to property, or to the marine, coastal, or human environment, to the national

security or defense, or in the event that the federal government decides to put the leased site to another use. In the event the aquaculture lease must be terminated for reasons of national or defense security or in the event that the federal government decides to put the leased site to another use, the offshore aquaculture firm should be provided with reasonable compensation.

Disposition of Facilities upon Termination

Lease terms will require the leaseholder to remove all facilities and equipment and restore the leased area back to its original condition at the end of the lease. If the lessee fails to do so, the improvements will be removed and subsequently confiscated, and the lessee will forfeit its performance bond to pay for such removal.

Abandonment of Facilities

Management of this phase of the offshore aquaculture development process can seek lessons from the experience of the Minerals Management Service in administering its responsibilities under the Outer Continental Shelf Lands Act. With regard to offshore oil production platforms, MMS regulations provide that all structures shall be removed from a lease within one year after lease termination. Lessees are obligated to verify site clearance for an area wider than the facility (for platforms, it is a 1,320-foot radius circle centered on the platform). For structures located in water depths of greater than 300 feet, the requirement for site clearance verification is a sonar search of the location; for waters depths of less than 300 feet, 100% of the area must be trawled in two directions, bringing up and disposing of all objects caught in the trawl (Waldemar 2001).

The important aspect here is to establish requirements for offshore aquaculture operators to remove all facilities and return the leased area to its original state. In many cases, the leasing agency will require that the operator establish an escrow account or provide a performance bond sufficient to pay for both the removal of all structures and the restoration of the area to pre-use conditions.

NPDES Permits

Several classes of pollutants are associated with aquaculture: fish meal, nutrient wastes and chemical pollutants. Thus, in addition to an aquaculture lease and

a Section 10 permit under the RHA, a Section 402 National Pollutant Discharge Elimination System (NPDES) CWA discharge permit is required, depending upon the characteristics of the facility. Section 401 of the CWA, 33 U.S.C. § 1341, which would otherwise require a federal permit applicant to receive certification from a state that its discharge is in compliance with state water quality standards, is not applicable in federal offshore waters because the jurisdictional reach of the states under Section 401 only extends three miles offshore. See 33 U.S.C. § 1362(8); *NRDC v. EPA*, 863 F.2d 1420 (9th Cir. 1988).

Section 301 of the CWA prohibits the discharge of pollutants except in compliance with the requirements of the Act, including the obligation to obtain a Section 402 (NPDES) permit. Thus, persons desiring to discharge pollutants into the territorial sea, contiguous zone or ocean must first obtain an NPDES permit that mandates compliance with effluent limitations, standards of performance, and Section 403 ocean discharge criteria adopted by EPA. More specifically, an implementing regulation, 40 C.F.R. § 122.24(a), requires that a "concentrated aquatic animal production facility" (CAAPF) obtain a NPDES permit. CAAPFs are defined as "a hatchery, fish farm, or other facility which meets the criteria in Appendix C... or which the Director designates" on a "case-by-case" basis after finding that it is a "significant contributor of pollution to waters of the United States." 40 C.F.R. § 122.24(b-c).

As set forth in Appendix C of the regulation, if an aquatic animal production facility discharges at least 30 days in a year and exceeds certain production limits, it is "concentrated" within the meaning of the rules, and thus requires a permit. Facilities that grow or hold cold-water fish or other aquatic animals and that produce less than 9,090 harvest weight kilograms (approximately 20,000 pounds) in a year and that feed less than 2,272 kilograms (approximately 5,000 pounds) of food during a calendar month are excluded. Facilities that grow or hold warm water fish or other aquatic animals and that produce less than 45,454 harvest weight kilograms (approximately 100,000 pounds) in a year or that employ closed ponds that discharge only during periods of excess runoff are excluded. This rule is often confused with another discharge regulation related to aquaculture, 40 C.F.R. § 122.25, which regulates the discharge of pollutants into an aquaculture project. This latter provision, however, has no bearing on discharge from aquaculture facilities.

LEASING AND PERMITTING

In 2004, EPA promulgated a final rule codified at 40 C.F.R. Part 451 that established CWA effluent limitations guidelines and new source performance standards for CAAPFs. As described in Chapter 1, the regulation provide technology-based narrative limitations and standards for wastewater discharges from new and existing CAAPFs that discharge directly to U.S. waters.

The rule applies to commercial (for-profit) and non-commercial (generally, publicly-owned) facilities that produce, hold or contain 100,000 pounds or more of aquatic animals per year. While facilities producing fewer than 100,000 pounds of aquatic animals per year are not subject to the rule, in specific circumstances they may still require NPDES permits that include limitations on discharges. As noted above, an aquatic animal production facility producing fewer than 100,000 pounds of aquatic animals per year will be subject to the NPDES permit program if it is a CAAPF as defined in 40 CFR 122.24. Certain other types of facilities also are not covered by the rule, including closed pond systems (most of which do not meet the regulatory definition of a CAAPF facility), molluscan shellfish operations, including nurseries, crawfish production, alligator production, and aquaria and net pens rearing native species released after a growing period of no longer than 4 months to supplement commercial and sport fisheries.

The final regulation applies to CAAPFs, producing more than 100,000 pounds per year of fish, located in the territorial seas, contiguous zone, or ocean waters. Any future CAAPFs that will produce more than 100,000 pounds per year of fish in the contiguous zone or in ocean waters are point sources that will be subject to the regulation as well as NPDES permitting requirements. It has been EPA's long-standing position that point source discharges subject to CWA requirements include the addition of a pollutant from a point source to waters of the contiguous zone or ocean except in limited circumstances. Consequently, discharges from net pens located in the contiguous zone or ocean waters, are subject to CWA requirements, including the guideline and NPDES permitting requirements.

On February 20, 2002, a federal district judge in Maine held that salmon net pen farms in Maine coastal waters are required to obtain CWA permits. *USPIRG v. Atlantic Salmon of Maine*, 215 F. Supp. 2d 239 (D. Maine 2002). Among other substances found to be "pollutants" under the CWA, were live non-native fish that escape,

fishmeal, and feces as well as pharmaceuticals and antibiotics associated with the aquaculture production process. Moreover, net pens were found to be point sources (see Firestone, J. and R. Barber 2003).

EPA and NOAA should work together to ensure a clear understanding and careful coordination of NPDES permitting requirements and offshore aquaculture including: scope and applicability of the NPDES program to offshore aquaculture; how NPDES permit decisions are made and processed; how permit terms and conditions are developed; permittee monitoring obligations; and how NPDES permit requirements are enforced.

Ocean Dumping Permits

With regard to ocean dumping permits under section 102 of the MPRSA, EPA regulates the transportation of material for ocean dumping to ensure that such disposal "will not unreasonably degrade or endanger human health, welfare or amenities, or the marine environment, ecological systems or economic potentialities." 33 U.S.C. § 1402(a). The MPRSA, however, explicitly excludes from its reach the deposit of oyster shells or other materials for the purpose of "developing, maintaining, or harvesting fisheries resources" provided that the activity is otherwise regulated or authorized by federal or state law. 33 U.S.C. § 1402(f). Thus, an aquaculture facility engaging only in onsite discharges associated with its operations and otherwise regulated or authorized by state or federal law (e.g., by NPDES permits or leases issued under a legal regime such as recommended in this report), would likely be subject to this exemption. Furthermore, under MPRSA section 102(d), no permit is required for the transportation for dumping or the dumping of fish wastes, except when deposited in harbors or other protected or enclosed coastal waters, or where EPA finds that such deposits could endanger health, the environment, or ecological systems in a specific location. Where the Administrator makes such a finding, such material may be deposited only as authorized by a permit issued by EPA. The limits established in any NPDES permit that is issued would presumably be set at levels that would not allow unreasonable degradation or endangerment of the marine environment.

CONSULTATION REQUIREMENTS THAT MUST BE SATISFIED

As noted above, the NOAA Office of Offshore Aquaculture would have overall responsibility for the review process associated with the aquaculture lease and necessary permits. That process will require NOAA to coordinate and consult with a number of federal agencies regarding potential impacts of the proposed aquaculture project on cultural artifacts and fish and wildlife as well as state review for impacts on land, water and natural resources within states' coastal zones.

Federal Agency Consultation and Coordination

Pursuant to section 106 of the **National Historic Preservation Act**, 16 U.S.C §470f, and 36 C.F.R. Part 800, the Army Corps must take into consideration cultural, religious, historic and archeological resources prior to permit issuance. Jurisdiction is generally confined to state waters, but could apply to federal waters if the issuance affected a viewshed or in some other way impacted property that has historic designation such as a historic district. In order to generate information on these resources, a permit applicant should prepare a report in consultation with the Advisory Council on Historic Preservation and submit it as part of its license application. Cultural, religious, historic and archeological resource impacts are evaluated further during the NEPA process.

Under the **Fish and Wildlife Coordination Act**, 16 U.S.C. §§ 661-666c, and other laws, any federal agency considering whether to issue a federal permit that will control or modify any body of water must consult with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, or both, as appropriate, as well as with the state agency exercising administration over affected wildlife resources. Moreover, under the Magnuson-Stevens Act a federal agency must consult with NMFS regarding actions they propose to authorize, fund or undertake that "may adversely affect" any essential fish habitat (EFH) and in many instances provide NMFS with a written assessment of the effects. 16 U.S.C. § 1855(b)(1)(D)(2). If the federal agency

does not follow NMFS recommendations, it must explain its decision in writing and describe the measures it will take to avoid, mitigate or offset habitat impacts. 16 U.S.C. §1855(b)(4)(B). Each Regional Fishery Council also will have established procedures for reviewing Federal or state actions that may adversely affect the EFH of a species managed under its authority. 50 C.F.R. § 600.930(a).

The **Endangered Species Act**, 16 U.S.C. §§ 1531 et seq., requires federal agencies that propose to issue permits to consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service prior to permit issuance in order to insure that the permitted activity is "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species," and to suggest reasonable and prudent alternatives. 16 U.S.C. § 1537(a)(2). More specifically, a three-step process must be followed to ensure compliance with the ESA. First, request of the Secretary of the Interior or Commerce or both, as appropriate, information as to whether any species which is "listed or proposed to be listed *may be present* in the area of such proposed action." 16 U.S.C. § 1536(c)(1). If a Secretary indicates that such a species may be present, the agency would then be required to conduct a "biological assessment for the purpose of identifying any endangered species or threatened species which *is likely to be affected* by such action." The assessment may be undertaken as part of complying with NEPA. If an endangered or threatened species is "likely to be affected," formal consultation of Section 1536(a)(2) and (b) is triggered.

Marine Mammal Protection Act of 1972, 16 U.S.C. §§ 1361 et seq., prohibits the harassment, hunting, capture or killing of marine mammals without a permit from either the Secretary of the Interior or the Secretary of Commerce, depending upon the species of marine mammal involved. Such permits only can be issued for limited purposes (for example, scientific research, public display, incidental takes).

LEASING AND PERMITTING

The **Marine Protection, Research and Sanctuaries Act**, 16 U.S.C. § 1434(d), requires that any federal agency proposing to take action (including actions authorizing private activities by licensees, lessees or permittees) “internal or external” to a National Marine Sanctuary that is “likely to destroy, cause the loss of, or injure any sanctuary resource,” is required to provide the Secretary of Commerce with a written statement

describing the proposed action and its potential effects. If the Secretary finds that such effects are likely, the Secretary is required to recommend to the federal agency reasonable and prudent alternatives to the proposed action. If, after consulting with the Secretary, the federal agency does not follow the Secretary’s recommendations, it must provide a written explanation for its decision.

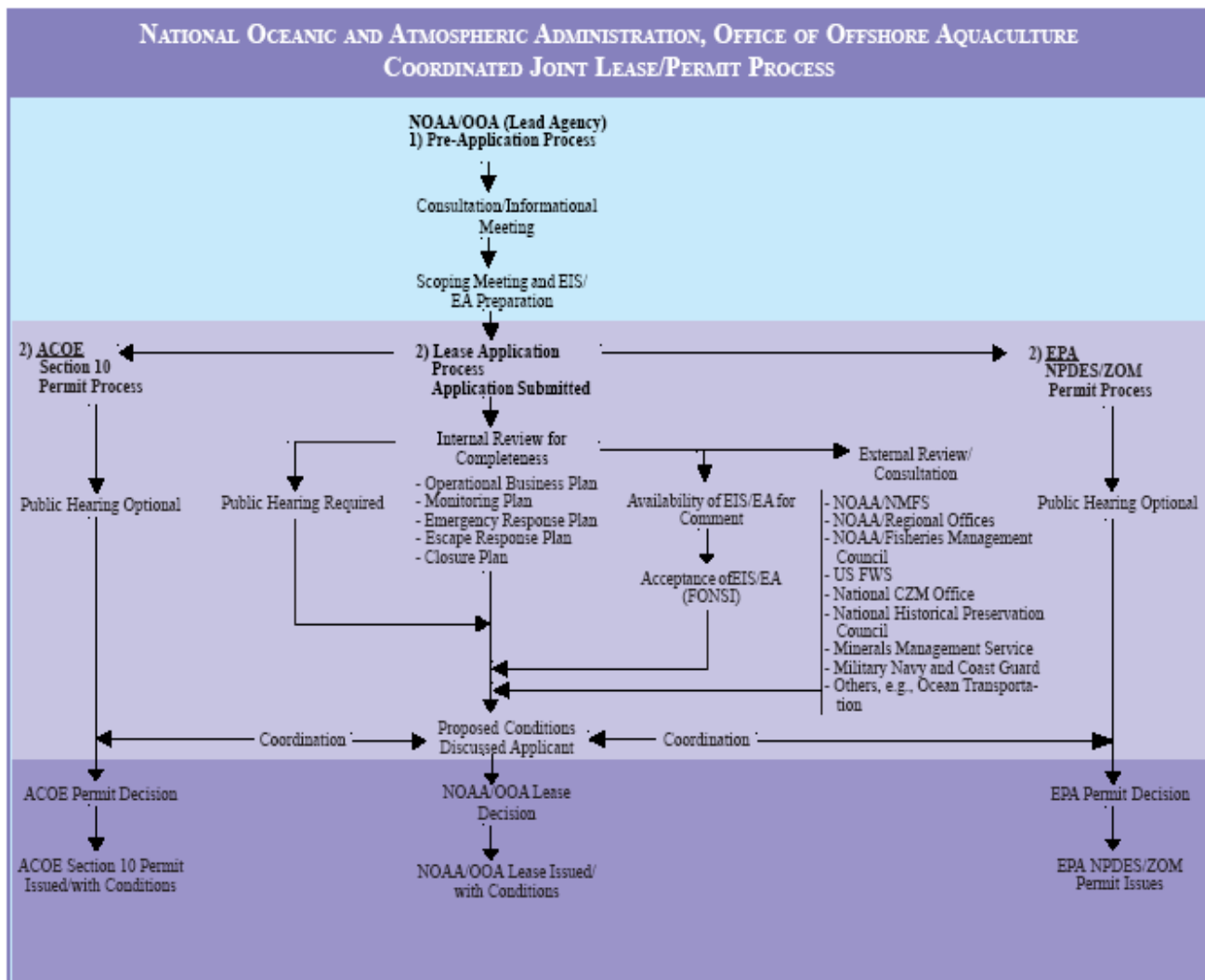


Figure 3.1: Flowchart for a coordinated joint lease/permit process, which would be administered by NOAA’s Office of Offshore Aquaculture.

Coastal Zone Management Act Certification

To the extent an aquaculture facility is well-sited 3 to 200 miles from shore, it may pose few problems for states other than potentially impacting onshore infrastructure requirements (staging areas and base yards to support offshore operations) and the possibility of escapees. However, under the **Coastal Zone Management Act (CZMA)**, 16 U.S.C. §§ 1451-1465, and implementing regulations, states develop coastal zone management programs subject to the review and approval of the Secretary of Commerce. To the extent that a federal aquaculture permittee's activity affects any land or water use or natural resource of a state's coastal zone, the permit applicant is required to certify that the project "complies with and will be conducted in a manner consistent with the management program" and to include the certification in the permit application. 15 C.F.R § 930.57(a). Simultaneously, the applicant is required to provide the appropriate state agency(ies) with a copy of the certification and any necessary supporting documentation (ibid). To the extent an offshore aquaculture project affects the coastal zone of more than one state, multiple certifications may be required. State concurrence is presumed if the state fails to act within six months. 15 C.F.R § 930.62.

If a state objects to the consistency certification, an applicant may appeal to the Secretary of Commerce. 15 C.F.R § 930.63(e). However, unless the Secretary finds that an aquaculture project is consistent with the "objectives or purposes" of the CZMA or is otherwise "necessary in the interest of national security," a federal licensing agency cannot issue an aquaculture permit. 15 C.F.R § 930.130(e). An applicant whose project was found by a state to be inconsistent with that state's coastal zone plan also could pursue remedies under state law.

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Recommendation 3.12

NOAA should coordinate reviews by agencies under other authorities such as the National Historic Preservation Act, the Endangered Species Act, the Marine Mammal Protection Act, the Fish and Wildlife Coordination Act, Magnuson-Stevens Fisheries Act, and the Coastal Zone Management Act.

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Recommendation 3.13

Fishery Management Councils (FMCs) should review applications for potential impacts on essential fish habitat and impacts on fisheries under their purview; however, requirements such as restrictions on the total allowable catch, seasons and ownership that FMCs apply to capture fisheries should not be applicable to offshore aquaculture. Aquaculture operations conducted pursuant to a lease and all necessary permits should be excluded from the definition of "fishing" under the Magnuson-Stevens Act, 16 U.S.C. § 1802 (15).

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Recommendation 3.14

It is critical for NOAA, the Army Corps, and EPA to involve states early in and throughout the zoning, leasing, and permitting processes, and states should receive timely and adequate notice as well as an opportunity to comment.

**SUMMARY OF LEASING
AND PERMITTING RECOMMENDATIONS**

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Recommendation 3.1

It is proposed that leasing and permitting proceed jointly given the time and efficiency gains that are expected from joint leasing and permitting without any loss of environmental protection.

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Recommendation 3.2

In light of the fact that joint leasing and permitting will require close coordination, the authors recommend that a formal mechanism be established to enable NOAA, the Army Corps of Engineers, and other interested federal agencies to cooperate with one another and to coordinate their respective reviews.

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Recommendation 3.3

A joint, multi-purpose lease/permit application form to guide review by all appropriate federal and state agencies and the public, should be developed for use by all applicants seeking to locate aquaculture facilities in federal waters.

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Recommendation 3.4

When applying for a standard offshore aquaculture lease and associated permits, the applicant should provide detailed information on the proposed aquaculture operation in the form of an Offshore Aquaculture Operational Business Plan.

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Recommendation 3.5

Congress should create a new aquaculture leasing authority, vest that authority with NOAA, and direct the Army Corps of Engineers to focus its Section 10 review on national security and navigation and to rely on the NOAA-coordinated environmental evaluation. Leases should spell out terms of tenure and operational parameters.

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Recommendation 3.6

The NOAA Office of Offshore Aquaculture should have the authority to grant offshore aquaculture leases for areas in, on, and under federal waters and the responsibility to administer and monitor all offshore aquaculture leasing activities.

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Recommendation 3.7

It is proposed that the NOAA Office of Offshore Aquaculture facilitate inter-agency interaction with other relevant permitting agencies, so as to create a one-stop process for applying for offshore aquaculture leases and permits.

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Recommendation 3.8

Four types of leases should be authorized:

- (1) A research lease to encourage the development and testing of new gear or techniques and to allow for scientific research;*
- (2) A short-term (or interim) lease to enable an aquaculture firm to further develop the facility's Offshore Aquaculture Operational Business Plan;*
- (3) A long-term (or standard) lease for an applicant with a fully developed Offshore Aquaculture Operational Business Plan; and*
- (4) An emergency lease to provide the culturist with a rapid response capability in the event facilities must be temporarily moved or relocated.*

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Recommendation 3.9

Consideration needs to be given to the cumulative impacts of offshore aquaculture facilities and, consequently, spacing and fallowing guidance should be developed by the NOAA Office of Offshore Aquaculture.

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Recommendation 3.10

Adoption of a mechanism similar to the Request for Information and Interest (RFII), utilized by the Minerals Management Service in leasing sand and gravel resources, should be incorporated into the offshore aquaculture leasing program adopted by the NOAA Office of Offshore Aquaculture. The RFII process should be enhanced by requiring the scheduling of public hearings for areas potentially affected by the proposed offshore aquaculture operation.

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Recommendation 3.11

In exchange for the semi-exclusive use of offshore space for aquaculture, the NOAA Office of Offshore Aquaculture should establish rental fee and royalty rates after due consultation with the offshore aquaculture industry, other ocean user constituencies, the public, and other federal agencies.

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Recommendation 3.12

NOAA should coordinate reviews by agencies under other authorities such as the National Historic Preservation Act, the Endangered Species Act, the Marine Mammal Protection Act, the Fish and Wildlife Coordination Act, Magnuson-Stevens Fisheries Act, and the Coastal Zone Management Act.

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Recommendation 3.13

Fishery Management Councils (FMCs) should review applications for potential impacts on essential fish habitat and impacts on fisheries under their purview; however, requirements such as restrictions on the total allowable catch, seasons and ownership that FMCs apply to capture fisheries should not be applicable to offshore aquaculture. Aquaculture operations conducted pursuant to a lease and all necessary permits should be excluded from the definition of “fishing” under the Magnuson-Stevens Act, 16 U.S.C. § 1802 (15).

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Recommendation 3.14

It is critical for NOAA, the Army Corps, and EPA to involve states early in and throughout the zoning, leasing, and permitting processes, and states should receive timely and adequate notice as well as an opportunity to comment.

CHAPTER

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PLANNING AND SITE ASSESSMENT FOR OFFSHORE AQUACULTURE

HISTORY AND IMPORTANCE OF PLANNING AND SITE ASSESSMENT

Typically, the actions of planning, site assessment and zoning for land-based resources serve as an extension of a federal, state or local government's police power, with the goal of promoting the general public's health and welfare. Traditionally, planning powers have been exercised at the local level, with local governments adopting land use ordinances to manage conflicting uses and promote safety. A common format for planning combines a map and text, describing the uses allowed in the area designated on a map. Similar and compatible activities are grouped together, such as residential and public recreational areas, or commercial and light industrial uses. These use combinations allow designated activities to grow in predictable directions and ensure that incompatible uses will not interfere with each other. This smart growth allows for stability within different sectors of a community, efficiency in meeting regulatory requirements, and greater security in investments.

Little has been done to determine the best-suited and environmentally appropriate offshore areas for marine aquaculture development. Natural resource and land use managers have employed planning and zoning as some of their most powerful tools over the last century. The marine environment can benefit from similar tools as users increase, the social efficiency of marine industries decreases, and the health of marine ecosystems declines. Advanced planning assists environmentally appropriate siting, reduced user conflicts, and a

thorough and efficient process for streamlined review, permitting, and leasing.

The critical importance of thorough pre-operational planning and site assessment to sustainable offshore aquaculture production cannot be overemphasized. This point is underscored by the estimated multi-million dollar capital and operational costs for development of offshore aquaculture farms (Waldemar Nelson International, Inc. 2001).

Siting decisions based on insufficient or faulty information can create costly delays, environmental degradation, reduced production, leasing issues, licensing and other regulatory requirements, or ultimately, project failure. A comprehensive feasibility study to identify and evaluate relevant technical, environmental and financial factors is a fundamental prerequisite for prospective aquaculture operations in coastal and open ocean environments. Companies seeking to develop open ocean aquaculture projects should conduct pre-operational surveys and develop detailed Offshore Aquaculture Operational Business Plans describing technical and environmental specifications, from initial siting needs through project termination.

The orderly development of an offshore aquaculture industry depends upon private businesses and the relevant government agencies assuming mutual responsi-

PLANNING AND SITE ASSESSMENT

bility for planning and site assessment. Federal authorities, charged with regulatory oversight of federal offshore waters, should assume the primary responsibility for identifying suitable sites or zones for aquaculture development. The government may designate the den-

sity and scope of aquaculture activities permissible in approved sites or zones based on detailed technical surveys, site mapping and application of criteria designed to address technical, environmental and socio-economic issues and concerns.

KEY ELEMENTS OF PLANNING

Initially, planning for offshore aquaculture areas will require the designation of one government agency to be responsible for siting, management of the designated sites, issuance of water column and seabed leases, and issuance of a permit that incorporates the concerns of other relevant federal and state agencies.

Preliminary planning should expand on the goals and selection criteria that are set out in existing legislation. In addition to identifying candidate sites and ecosystems, the responsible government agency must describe habitats, species' characteristics, and species' ranges in order to identify areas most appropriate to either use or protect. At the same time, the social dimensions of resource use must be documented to identify the full costs and benefits of siting or restricting particular uses in a given area. The agency should identify site-specific goals, objectives, prohibitions, and permitted uses. This information should be included in a site-specific management plan. In setting up a planning scheme for offshore aquaculture, the following key elements must be addressed by both the government agency and the culturist.

Surveys

Planning for offshore aquaculture should begin with comprehensive delineation of the environmental characteristics and traditional uses of offshore areas. Mapping of federal waters is a daunting and multi-year task and while some mapping of federal waters is underway, the interim steps noted below can be used to begin the planning process for offshore aquaculture.

A survey of the area, preferably using GIS (geographic information systems) or other remote mapping techniques should be available. It should delineate physical, chemical and biological environmental information relevant to offshore aquaculture uses (such as depth, temperatures, current, and area-specific ecologi-

cal factors).

U.S. coastal waters represent a public resource for use by fishers, recreationalists, mineral exploiters, the military, and the shipping industry. Mapping the offshore area to delineate traditional users and special environmental concerns will provide a strong foundation for an offshore planning effort. For example, the agency can identify those areas already being overused, having existing user conflicts; or having known environmental aspects that eliminate the area as an appropriate offshore aquaculture site. By eliminating these areas as potential sites, the agency can then determine which of the remaining sites should be opened for aquaculture after an environmental review.

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Recommendation 4.1

It is recommended that comprehensive mapping of offshore areas be conducted to identify areas suitable for the offshore aquaculture industry as well as other uses and to further the development of a detailed, map-based marine zoning plan.

Socio-Economic and Environmental Issues

The maps provided by the above survey should provide overlays detailing the various human uses of the area. Overlays should typically include such uses as: offshore mineral development or energy development; capture fisheries; recreational uses; shipping channels; the presence of endangered, threatened or sensitive species; military uses; marine protected area status; or

other aquaculture development.

Design/Engineering

The planning process should provide guidance for the design of offshore aquaculture facilities that are compatible with an area's ecosystems and uses.

Legal and Regulatory Requirements

Comprehensive planning for offshore aquaculture must recognize the legal and regulatory requirements applicants must satisfy to engage in an offshore aquaculture operation. As discussed in Chapter 3, included are federal permitting and review requirements of the Clean Water Act (CWA), National Environmental Policy Act (NEPA), Rivers and Harbors Act (RHA), as well as other federal legislation and potential individual state requirements. A siting plan should alleviate possible redundant permit requirements by addressing the requisite environmental review. Furthermore, if site designation and planning has been mandated by umbrella legislation, then the site-specific management plan can be used to develop the enforceable regulations that authorize specific use and protection for an area. In addition to implementing these rules, the day-to-day procedures necessary to administer the area must be set up (e.g. accommodating other users and enforcing regulations).

Federal agencies are required to comply with NEPA, which in section 102 requires all federal agencies to include a detailed statement of the environmental impact of a major federal action that significantly affects the environment. A "major" federal action is one that requires substantial planning, time, resources, or expenditure that the federal agency proposes or permits. Through the Environmental Assessment (EA) and Environmental Impact Statement (EIS) reviews, agencies are forced to consider environmental impacts before action is taken. In addition, NEPA mandates coordination and collaboration between federal agencies. Specifically, prior to making any detailed statement, the responsible federal official must consult with and obtain the comments of any federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. For practical purposes, NEPA's mandates do not extend beyond this consultation stage. The Supreme Court has declared that NEPA's reach is procedural rather than substantive: NEPA cannot mandate particular results but only prescribe the necessary process. Thus, once a federal

agency has completed the "detailed statement" that NEPA requires, it may then continue its proposed activity.

Public Input

Having noted the specific requirements of environmental assessment under NEPA, the planning process for aquaculture siting should involve two stages of public input. The first stage occurs when a planning project commences. It offers the public and interested parties an opportunity to comment on management issues relevant to the area. The second stage of public input is designed to provide opportunities for the public to comment on the prepared final plan. After the second stage of input, the agency may require revision of the plan to address public comments.

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Recommendation 4.2

Two stages of public review, including the scheduling of public hearings for areas potentially affected by a proposed offshore aquaculture operation, are recommended for the planning process: upon commencement of the planning process and upon completion of the final plan.

The Offshore Aquaculture Operational Business Plan

Finally, the planning approach should provide adequate guidance for the creation of business management and implementation plans, noting the key elements a culturist must prepare in order to receive permits and meet the requirements as determined under the site assessment. These elements include a physical description of the aquaculture facility and mooring system, information necessary to support an environmental review of the site, a description of the use profile of the immediate vicinity, and an evaluation of cumulative impacts. Such plans were detailed in Chapter 3.

REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS AS PLANNING TOOLS

Canada, New Zealand, Australia, the United States and other countries with developing marine aquaculture (and other open-ocean industries) have programs in various stages of development and technical sophistication to identify and inventory important marine resources and activities within their jurisdictions. Technical information is obtained via a variety of remote sensing methods including: high resolution satellite imagery; aerial photography; single, multiple beam, and side scan sonar; global positioning systems (GPS); and related technologies. Information from oceanographic, biological, geological and diver surveys provides additional detail and is used to ground truth remote sensing data. Relevant social, political, economic and legal factors are also incorporated into the process.

The collection, organization and analysis of coastal and oceanic spatial data are part of the growing technical field of marine geomatics. Geomatics involves the measurement, analysis, management, retrieval and display of earth-based or geographically-referenced information (University of New Brunswick 2002). Databases containing physical, chemical, biological and other categories of information are integrated and displayed with computerized geographic information systems (GIS), using specialized software capable of generating graphic comparisons or overlays of selected data sets. Advances in remote sensing methods and GIS technologies have greatly improved the ability of resource managers to characterize and monitor the impacts of human activities on coastal and ocean environments (GESAMP 2001). Remote sensing and GIS are currently applied in a variety of aquatic science fields (University of New Brunswick 2002).

Use of geographic information systems in the planning effort to integrate aquaculture with other uses of open ocean waters is a relatively new application of the technology. Kapetsky (2000) conducted a survey of GIS applications in aquaculture. He subsequently reviewed and categorized 102 examples of geographic information systems used for aquaculture between 1985 and 1998 (Table 4.1).

Kapetsky (2000) reported that:

- GIS applications in aquaculture date only from 1985;
- The largest number of GIS applications were based in the United States;
- The great majority of GIS applications were aimed at coastal aquaculture, while nearly all of the remainder were for inland areas. Only one application was offshore.
- Geographical gaps are evident in the patchiness of GIS applications within large countries and also among countries, regions and continents.
- GIS aimed at aquaculture development is relatively well covered (Table 4.1), with little attention given to the environmental impacts of aquaculture.

Kapetsky (2000) observed that the multi-disciplinary and spatial nature of aquaculture siting, operation and environmental monitoring are ideally suited to a range of uses for GIS, particularly in the context of other uses for land and water as well as integrated multi-sector development and management plans. Benefits of using this approach include:

- Improved allocation of resources;
- Reduced resource/user conflicts;
- More appropriate aquaculture siting; and
- Increased potential for operational success of aquaculture ventures through comprehensively matching aquaculture technologies with the natural environmental, human and financial resources.

Current, state-of-the-art geographical information systems are already demonstrating their practical value for aquaculture planning and siting decisions. The Newfoundland and Labrador Department of Fisheries and Aquaculture (DFA), for example, maintains an Internet-based Aquaculture Geographic Information System (AquaGIS) <<http://www.aquagis.com>>. This system is designed to integrate relevant information on aquaculture, fisheries and coastal zone resource management for use by the private and public sector regarding economic/financial, environmental and regional planning activities. AquaGIS is an important component of the aquaculture licensing process administered by the DFA.

Table 4.1 Categories and Numbers of Geographic Information Systems Applications in Aquaculture**GIS Training and Promotion**

- Training (7)
- Promotion of GIS (13)

GIS Aimed at Development

- Suitability of the site (16)
- Strategic Planning for aquaculture development (20)
- Anticipating the consequences of aquaculture (8)
- Web-based aquaculture information systems (1)
- Marketing (1)

GIS in Culture Practice and Management

- Inventory and monitoring of aquaculture and the environment (24)
- Environmental impacts of aquaculture (2)
- Restoration of aquaculture habitats (1)

Multi-Sectoral Planning that Includes Aquaculture

- Management of aquaculture together with fisheries (3)
- Planning for aquaculture among other uses of land and water (6)

(Kapetsky 2000)

The web site provides online access to relevant geographic information such as:

- Current, pending, approved and available aquaculture sites;
- Environmental data, including an inventory of marine plant and animal resources;
- Cultural data including local governmental jurisdictions, environmentally sensitive/protected areas and economic development zones; and
- Baseline information on land use, topography, hydrologic data and other resources.

Due to limited availability of land and water resources and the high potential for use conflicts in the State of Hawaii, the state Aquaculture Development Program has been evaluating the use of a geographical information system for aquaculture site analysis and selection. The Hawaii GIS incorporates information on bathymetry, hydrographic and bottom conditions, and pre-existing uses such as the location of harbors, sewer outfalls, telecommunication cables, offshore shipping lanes, anchorages, and sensitive habitats. Analysis and modeling of the data proves useful as a planning and regulatory tool, identifying areas with high, marginal, and no aquaculture potential (Young et al. 2002, Corbin 2002).

PLANNING AND FRAMEWORK OPTIONS

A series of interrelated criteria should be investigated to determine appropriate coastal/offshore locations for aquaculture. Most of these criteria apply to all types of offshore operations while others may vary based on physical/biological requirements of candidate species, production level, farm density and the ecological sensitivity of a given location. Barg (1992) and the National Marine Fisheries Service (NMFS) (1998) summarize important biological, physical, social, and economic factors to be considered in the aquaculture planning and site selection stages. The following investigations of socioeconomic, physical, biological, and technical issues can increase the likelihood of successful planning. The list below would be tailored to the physical area under consideration as well as the actual elements of the planning process.

Socioeconomic Criteria

- Identify, and ensure the development of appropriate proposals to reduce or eliminate, threats to existing nature conservation values, cultural/heritage values, or scientific values
- Ensure, through effective management, the recovery and continued protection/conservation of vulnerable or endangered species and economic communities that are, or may become, vulnerable or endangered;
- Ensure that activities are managed on the basis of ecologically sustainable use;
- Provide a basis for managing the resource conflicts with other established or emerging ocean uses such as navigation; recreation; commercial and sport fisheries; essential fish habitat; marine sanctuaries and reserves; historic/cultural sites; marine mammal and other species interactions; and military operations;
- Allocate environmental capacity in terms of waste production/emission limits for aquaculture and other activities;
- Provide for the management of areas in conjunction with community groups where those groups have a special interest in the areas concerned; and
- Enable people using the area to participate in rec-

reational opportunities, consistent with the goals of the area and other uses;

- Anticipate economic viability and community impact (employment, markets, goods and services);
- Maintain environmental/ecological integrity (environmental assessment and monitoring programs);
- Encourage public consultation and involvement in the site allocation process;
- Protect the public trust: lease, permit, and license fees;
- Create zones with development and environmental objectives specifically related to aquaculture and other compatible activities;
- Establish production targets related to the development of potential and social-economic objectives (GESAMP 2001).

Physical Criteria

- Assess access to high quality water;
- Specify baseline environmental quality;
- Determine sufficiency of tidal or current flow for waste transport and diffusion;
- Investigate bottom topography and sediment characteristics for anchors, moorings, and other structures; and
- Other important physical considerations include: water depth, water chemistry, salinity and dissolved oxygen profiles, solar irradiation, temperature, wind energy and other meteorological factors, and degree of exposure based on annual wind, tidal and wave energy patterns.

Biological Criteria

- Measure primary productivity, ambient nutrient levels, photosynthetic activity, and the presence of harmful algal blooms;
- Determine occurrence of natural predators, endemic diseases, and parasites;
- Assess abundance and distribution of wild populations, and potential for biological interactions; and

- Ascertain ecological conditions, including the diversity, structure and interaction of benthic and pelagic communities.

Technical Criteria

- Specify geographic boundaries, including total area to be occupied by the lease;
- Research history of the site, including prior uses and outcomes;
- Categorize the operation (for example, shellfish vs. finfish) and production level (biomass, intensity);
- Investigate facility design, engineering, construction and maintenance;
- Determine appropriateness of technology, operational plan and husbandry methods;
- Assess proximity and access to maintenance, processing, and other on-site or land-based support facilities;
- Examine emergency, contingency and termination plans; and
- Certify financial status of the company and access to capital and credit.

A planning and management strategy for the location and siting of aquaculture development should be incorporated into a comprehensive Integrated Coastal Management approach (Barg 1992). This inclusion of aquaculture use with other sector activities or plans would involve technical and economic assessments of costs and benefits. Further, by identifying and evaluating likely adverse environmental and social impacts, this approach prevents activities from exceeding the carrying capacity of the environment. Anticipated negative impacts may be maintained within acceptable, pre-determined limits through regulatory oversight, monitoring and contingency planning.

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Recommendation 4.3

A planning and management strategy for the location and siting of offshore aquaculture development should be a component of a comprehensive ocean and coastal management approach including consideration of socioeconomic and environmental criteria.

OPTIONS FOR OFFSHORE AQUACULTURE SITING

Site-Specific Lease or Easement

Leases or easements may be granted on a case-by-case basis. The leasing agency should take into account the following to assess the suitability of a lease or easement for offshore aquaculture in a particular area:

- Project-specific and area-specific factors;
- Limits on authority to issue a marine aquaculture lease for the surface, water column, and bottom of an area;
- Appropriateness of restrictions on the lease including: individual and aggregate area limits, limits on the number of leases held at a given time, time limits for leases, and limits on purposes for which leases are granted;
- Associated costs for leasing;
- Method of public notice and review; and

- Specific conduct for the leased activities, including interference with rights of riparian owners, navigation, other uses, and the ability of area to support existing ecology.

Pre-Permitted Site

A governmental entity may elect to pre-permit a site or designate an area as open for particular individual uses such as marine aquaculture. The entity must perform the following functions in order to create a pre-permitted site:

- The entity conducts environmental assessment and baseline studies.
- From the assessment, the entity creates a Master Plan for siting in the area and a Master Environmental Approach determining which techniques and projects are appropriate for that area. A Mas-

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ter Permit is then prepared for uses in the area.

- The entity submits the assessment, plan, and permit to relevant state and federal agencies for approval before the site is pre-permitted.
- The entity issues general permits for the area to address state and federal regulatory requirements.
- The entity then approves individual uses for the area through an application process.

Designated or Pre-Approved Area

A governmental entity may elect to designate a pre-approved area for short-term leasing. This option will likely be best used with small-scale or pilot-project designations that do not require long-term approval or a lease. The following steps should be followed:

- The entity conducts a survey and determines that the area is an appropriate site for aquaculture.
- Aquaculture is designated as a pre-approved activity, along with other activities that can co-exist.
- The entity then requires culturists interested in using the site to conduct environmental assessments for their particular type of aquaculture in order to ensure that the equipment, species, medicines, and feed are appropriate for the designated area.
- Following the environmental assessments, the activity may begin with simplified permitting.

Zoned Areas for Multiple Use

A multiple-use area would allow for compatible uses that may fall under several categories including: prohibited activities, which may not be applied for under any circumstances; non-complying activities, which are excluded unless the effects are minor or the activity does not conflict with the zoning plan; discretionary activities, which are generally considered suitable for the area, subject to site considerations; controlled activities, which may proceed, provided they meet performance criteria; and permitted activities, which are allowed without a specific permit. To determine which uses should be allowed, the following standards should be considered:

1. The proposed use is consistent with the purpose of marine industrial districts and with the services of those industries;

2. The proposed use is compatible with existing use plans for the area and with the relevant coastal zone management plan; and
3. Public facilities and services are adequate to serve the proposed use.

Buffer zones around the new or expanded development activities may also be delineated, with a minimum of 100 feet between the facility and the buffer zone, taking into account factors such as:

- The use is water dependent.
- The project meets a recognized private right or public need.
- Adverse effects on water quality and on fish, plant, and wildlife habitat are minimized.
- Insofar as possible, non-water dependent structures or operations associated with water-dependent projects or activities are located outside the minimum 100-foot buffer.
- Water-dependent research facilities or activities operated by State, Federal, local agencies, or education facilities, may be permitted in the buffer if nonwater-dependent structures or facilities associated with these projects are located outside the buffer.
- Commercial, water-dependent fisheries facilities may be permitted in the buffer, including, but not limited to structures for: crab shedding; fish off-loading docks; shellfish culture operations; shore-based facilities for aquaculture operations; and fisheries activities.

For example, a buffer of twenty-five meters can be left between existing farms and the zone boundary except where the area is unsuitable or farmers have requested that the zone boundary follow the edge of existing leases. This buffer allows for small lease alterations that may be requested in response to changing farm management practices.

Recently, the Australian government approved the development of nine new marine aquaculture zones (totaling more than 2400 hectares) in the state of Victoria. Prior to allocation of the areas, each zone will have a management plan prescribing operational, environmental, and administrative elements. The zones are potentially available for mussels, scallops, abalone, and pearls.

Marine Aquaculture Parks

The purpose of the park is to provide adequate space for aquaculture operations, best suited to the environmental characteristics of the area, and to minimize conflicts among industrial, commercial and recreational uses with optimum access to land-based and coastal area services.

The park may be delegated to a private sector entity, or managed by either a public sector entity or a mixed public/private partnership. In an aquaculture park, the government could provide the necessary infrastructure and dictate the types of aquaculture allowed in the park.

One method to create the park is through the designation of a Special Management Area (SMA). This type of marine park balances the needs for water-dependent development and environmental conservation through efforts between local and state governments as well as through federal authorities, in an effort to resolve development conflicts before they occur. Through a Special Area Management Plan, an area can be managed as an industrial or port area, a beach access area, or an urban waterfront for residential or commercial areas adjacent to the waterfront. Ports are often managed under such a plan which provides management guidelines, a dredging plan, an area development plan to show proposed limits on development in the area, and a mitigation program to compensate for environmental losses from development allowed in the area.

The following elements should be used in creating a Marine Aquaculture Park:

- The government provides initial investment in infrastructure and staffing (for a long-term payback from occupants).
- The government provides the initial baseline studies and environmental assessment information, determining, as above, the types of aquaculture best suited for the park.
- Initially, occupants receive economic incentives such as low rents or offsets in return for a share in the success of the operation.
- A portion of the facility should be designated for short-term use to allow incubation of future companies as well as short-term research projects; in

addition, a portion should be leased long-term to qualified companies in order to provide a base of operating support.

- The park may be linked to local educational and community activities through outreach programs.

The Natural Energy Laboratory of Hawaii provides a good model for an aquaculture park, based on housing tenants that have different emphases and are at varying levels of development. For instance, tenants in an aquaculture park, set up like the energy laboratory, may be in any of the following categories:

- *Pre-Commercial Tenants* — those who have projects with commercial potential, but which still require a period of research and development in order to solve production problems or optimize production methods;
- *Commercial Tenants* — those with technical and production expertise and a prepared business plan who are ready to move on to commercialization;
- *Research Tenants* — those with scientifically-sound research projects of their own design who can utilize the unique resources at the park; and
- *Education Tenants* — those with short or long-term education and/or training programs, which can complement the activities and industry development occurring at the park.

Through development of a framework like the marine aquaculture park, the rent base and profit base provided by existing tenants allows for a government to both maintain the park and invest in future endeavors (aquaculture or other).

Complete Mapping/Zoning: Elements of a GIS-based mapping approach to zoning

Zoning separates activities that may conflict with each other, such as commercial fishing and aquaculture. Zoning also allows areas that need permanent conservation to be protected from potentially threatening processes by being placed off-limits to users (except for the purpose of scientific research) for varying lengths of time. Marine zoning plans prove similar to planning schemes prepared for local government areas. For example, zoning plans provide for activities that are allowed by right (based on historical use or an existing

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property right), allowed with permission, or prohibited. Each zone category specifies which activities can or cannot be undertaken and whether or not permission is required to undertake those activities. Principal objectives of a zoning plan should be:

1. The conservation of the area;
2. The regulation of uses in the area to provide for reasonable use;
3. The regulation of activities that exploit area resources, to minimize the effect of those activities on the area; and
4. The reservation of some areas for traditional uses.

There are generally seven stages in the development of a zoning plan for a marine area:

1. *Initial information gathering and preparation.* The agency assembles and reviews information on the nature and uses of the area. It also develops systems for public participation.
2. *Public participation and consultation before the preparation of the plan.* The agency seeks public comment on the accuracy and adequacy of the information. It then gathers suggestions for the content of the zoning plan.
3. *Preparation of a draft plan.* The agency prepares a draft zoning plan, specifying the objectives defined for each zone.
4. *Revision of the draft plan through public participation and consultation.* The agency seeks comment on the published draft plan.
5. *Consideration of public comment and finalization of the plan.*
6. *Adoption of the revised plan.* The plan now takes into account the comments and information received in response to the published draft plan.
7. *Submission of the plan to the relevant government agency for review and approval.*

Zoning maps are then prepared and distributed, showing what activities are permitted and in what areas. In addition, continued research, monitoring of area activities, and changing circumstances require that zoning plans be reviewed periodically. Example areas and re-

strictions for a zoning plan include the following:

- *General Use A Zone.* The least restrictive of the zones, this designation provides for all reasonable commercial uses including aquaculture, shipping, and trawling. Prohibited activities are mining and oil drilling.
- *General Use B Zone.* This zone provides for reasonable use, including most commercial and recreational activities. Prohibited activities include trawling and general shipping, as well as those activities not allowed in the General Use A Zone. Aquaculture is allowed in this zone.
- *General Use C Zone.* This zone provides areas for some recreational and commercial activities, consistent with the region's long-term conservation, including marine farming.
- *Habitat Protection Zone.* This zone provides areas free from the effects of trawling, while allowing for a range of recreational and other commercial activities consistent with sensitive habitat areas.
- *Restricted Zone.* This zone provides for appreciation and enjoyment of areas in their relatively undisturbed state. All activities that remove natural resources are prohibited.
- *Buffer Zone.* This zone provides for protected areas and allows opportunities for their appreciation and enjoyment while allowing for limited commercial use.
- *Scientific Research Zone.* Set aside exclusively for scientific research, this zone prohibits entry and use for other reasons.
- *Preservation Zone.* This zone provides for the preservation of the area in an undisturbed state. All entry is prohibited, except during either an emergency, or when permitted scientific research cannot be conducted elsewhere.



Recommendation 4.4

NOAA should consider the development of the following options for the placement of offshore aquaculture operations:

- *leases or easements granted on a case-by-case basis, taking into account environmental criteria of the area and project-specific factors;*
- *identification of sites suitable for the designation of **pre-permitted sites for marine aquaculture**, upon securing necessary general permits to address state and federal regulatory requirements;*
- *designated areas for short term leasing of small scale or pilot projects in locations to minimize impacts on other user groups and on the environment;*
- *zoned areas for multiple use, depending upon the appropriateness of the site and public input;*
- *marine aquaculture parks to provide initial infrastructure, environmental assessment information, and designated areas for pilot, research, and longer-term commercial projects.*

LONG-TERM U.S. GOAL: INTEGRATED MANAGEMENT OF FEDERAL WATERS

Currently, no clear authority exists to provide comprehensive management of federal waters. Legislation such as the Outer Continental Shelf Lands Act and the Magnuson-Stevens Fishery Conservation and Management Act cover certain activities in federal waters but there has been little legislative attention to determining domestic access to or allocation of federal waters resources. Conflicts between user groups often bear uncanny resemblance to conflicts between users on land and without legislation managing the resources of federal waters, conflicts and inequities are virtually certain to recur.

This gap has been discussed in a number of books and reports in recent years (e.g., NRC 1997, Cicin-Sain and Knecht 2000), and it represents a major emphasis of both the Pew Oceans Commission and the U.S. Commission on Ocean Policy. There is now clear consensus that a comprehensive planning effort should be undertaken.

A legislated system of management, allocation and licensing according to activity in an area may be the only means of avoiding conflicts and resource depletion. As space and resources become scarcer, efforts at both the state and federal levels are necessary to assess uses and needs for coastal and offshore areas.

It is recommended that the U.S. Congress develop legislation to support, develop, and implement a mapping, management, development, and conservation plan for U.S. federal waters that will address the needs of the offshore aquaculture industry and those of other users. Both the Pew and the U.S. Commission on Ocean Policy reports provide detailed recommendations for a comprehensive approach to governance of U.S. federal waters.

Capacity for undertaking comprehensive federal waters management (but not the explicit mandate to do so) is currently present at NOAA and at the U.S. Department of Interior. Three NOAA offices have special expertise in this regard: The National Ocean Service's Special Projects Office (which has done considerable work on ecosystem-based mapping and planning); the Coastal Services Center in Charleston (which has begun the process of mapping ocean processes and resources using Geographic Information Systems, and uses using the Southeast region as a model); and the Office of Ocean and Coastal Resource Management (which administers the coastal zone management program), which could serve as an effective bridge to state-based work.

At the Department of Interior, two agencies are particularly relevant: the U.S. Geological Survey which has

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the mandate to assess the public lands resources of the United States; and the Minerals Management Service with authority over offshore mineral resources and with much experience in the study of ocean resources and processes in U.S. federal waters. For this work to occur, of course, these agencies would need to be given an explicit mandate—either through administrative action or through new congressional action on aquaculture. Development of the aquaculture industry will be hindered if such planning does not take place on a timely basis.

The long-term goal should be implementation of legislation providing for management of federal waters. In the absence of legislation providing explicit authority for federal waters management, executive action can

provide an explicit mandate to NOAA and the Department of Commerce to provide assessments of federal waters areas that are suitable for various uses, including aquaculture, through mapping, analysis, and planning. Royalties from offshore uses, including energy uses, mineral extraction, and leases can be used to fund comprehensive mapping and zoning efforts.

In the short-term, steps toward the systematic analysis of federal waters resources and uses must be undertaken and assistance provided, on a timely basis, in identifying areas particularly suited (and not suited) for offshore marine aquaculture operations. The new NOAA Office of Offshore Aquaculture should be given the lead responsibility, authority, and resources to provide these interim services.

SUMMARY OF PLANNING AND SITE ASSESSMENT RECOMMENDATIONS

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Recommendation 4.1

It is recommended that comprehensive mapping of offshore areas be conducted to identify areas suitable for the offshore aquaculture industry as well as other uses and to further the development of a detailed, map-based marine zoning plan.

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Recommendation 4.2

Two stages of public review, including the scheduling of public hearings for areas potentially affected by a proposed offshore aquaculture operation, are recommended for the planning process: upon commencement of the planning process and upon completion of the final plan.

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Recommendation 4.3

A planning and management strategy for the location and siting of offshore aquaculture development should be a component of a comprehensive ocean and coastal management approach including consideration of socioeconomic and environmental criteria.

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Recommendation 4.4

NOAA should consider the development of the following options for the placement of offshore aquaculture operations:

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- *zoned areas for multiple use, depending upon the appropriateness of the site and public input;*
- *marine aquaculture parks to provide initial infrastructure, environmental assessment information, and designated areas for pilot, research, and longer-term commercial projects.*

CHAPTER

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ENVIRONMENTAL REVIEW OF OFFSHORE AQUACULTURE

INTRODUCTION

Evidenced by original research and review publications, environmental impacts of marine aquaculture have received increased attention in recent years (for example, Halvorson 1993, Goldberg and Triplett 1997, Naylor et al. 1998, Rosenthal et al. 1999, Cicin-Sain et al. 1999, 2001, DeVoe 1992, Tlusty et al. 2001). As the United States considers the use of federal waters for marine aquaculture, serious attention will have to be given to sustainability (Chamberlain and Rosenthal 1995; PACON 1995) and to limits and standards for environmental effects (Heinig 2001). Few examples of offshore aquaculture on a commercial scale exist, thus making it difficult to predict all potential effects.

Due to the relatively high level of uncertainty associated with offshore aquaculture, it is preferable that the environmental review process be both flexible, with respect to different types of aquaculture operations, and adaptive in response to monitoring results.

In marine aquaculture, natural resources are consumed as feed, and wastes are deposited in the marine ecosystem, which may lead to exceeding the capacity of the natural ecosystem to support the activity while maintaining its own biological integrity. This is a critical issue for aquaculture practiced in near- or in-shore ecosystems, but exceeding carrying capacity may also become an issue for offshore aquaculture that becomes industrial in scale and methodology and emphasizes maximizing production over integrating with the natural sys-

tem and operating within its productive capacity. However, it is not essential to conduct aquaculture in this manner. The activity indeed lends itself to designs that more nearly mimic natural ecosystems, including, for instance, the employment of polyculture to produce natural feed, to clean up wastes with natural organisms, to enhance and protect fish habitat, and to restore biodiversity to depleted ecosystems. The effects of such aquaculture are more likely to be benign or even positive. Aquaculture that is well integrated into the natural biological cycles of marine ecosystems ought to be the goal of regulations and permitting standards, even though a considerable understanding of ecological principles would be required. Guidance from the academic and government research community will be essential. In order to encourage such practices, environmental standards, monitoring, and review must be clear and rigorous with a variety of incentives to reward successful efforts.

Several objectives should guide aquaculture development in federal waters and be incorporated into environmental review. To avoid harming large marine ecosystems and their wild fauna and flora and to enhance fisheries habitats whenever possible, open water aquaculture should incorporate and accommodate, not threaten, native biodiversity. This harmonization can be achieved by giving careful attention to the species and strains grown, as well as to the variety of species cultivated in a single facility and/or in the composite of operations in a region. The maintenance of good water

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quality is important to the aquaculture operation and the ecosystem that surrounds it, and a diversity of cultivated species can help maintain that quality. It is also important to minimize interactions between cultured organisms and wild organisms, with the goal of approaching zero interactions, and to minimize, mitigate, or monitor any impacts of such interactions, should they occur. Potential impacts include: competition between wild and cultivated species or individuals; interbreeding between wild and cultured individuals of the same species; and disease transmission in either direction. Environmental reviews should address these concerns. In order to do this sufficiently, a careful and complete environmental assessment of any proposed aquaculture site must be done before permits can be granted with appropriate conditions. The application of the National Environmental Protection Act (NEPA) to this process is an es-

sential component of aquaculture development in federal waters, despite some as of yet unsuccessful arguments that NEPA does not apply to offshore federal waters (for example, *NRDC v. U.S. Dep't of the Navy*, CV-01-07781 CAS [RZx]; C.D. Cal. Sept. 17, 2002).

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Recommendation 5.1

Congress should clarify and confirm that NEPA applies to federal waters and the continental shelf.

GUIDING PRINCIPLES AND CONCEPTS FOR ENVIRONMENTAL REVIEW

In the development and implementation of a framework for aquaculture development in federal waters, there must be an underlying assumption that the chemical and biological character of the marine ecosystem should be protected from degradation. Environmental reviews should be implemented to facilitate this end.

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Recommendation 5.2

Environmental impacts from aquaculture, such as those described in this chapter, should be avoided, minimized, or mitigated to the maximum extent possible.

Both internationally and in the United States, several principles and concepts have been accepted to guide the assessment and operation of activities with potential impacts upon natural ecosystems. Listed below and aired in the context of aquaculture, these principles and concepts should be basic to U.S. aquaculture policy in federal waters (see also our 2001 report, *Development of a Policy Framework for Offshore Marine Aquaculture*).

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Recommendation 5.3

A commitment to sustainability, application of the precautionary approach, concern for environmental carrying capacity, thorough scientific assessment and monitoring of the environment, ecosystem-based adaptive management, and public participation and transparency should guide environmental review of aquaculture in federal waters.

Sustainability

The UN Commission on Sustainable Development (CSD) definition, adopted also by the U.S. President's Council on Sustainable Development, is: "Sustainable development is development that meets the needs of the present without compromising the ability of future

generations to meet their own needs.” In federal waters, ecological sustainability is critical, since those ecosystems are essential for sustainable fisheries in the future and for services they provide in maintaining a healthy environment for the planet. The scientific risk of not fulfilling sustainability requirements should be estimated for aquaculture development in federal waters. While risk assessments should be conducted, it should be recognized that these exercises use scientific facts and judgments and ultimately feed into a process of management, in which political, social, ethical, and economic factors also play important roles and influence decisions.

Precautionary Approach

For activities that potentially pose negative environmental impacts, the precautionary approach suggests that one should not proceed with a proposed activity if there is a risk of irreparable harm to the environment, even if proof of harm is not possible. The approach goes beyond that to prescribe that, in the face of uncertainty, action be taken to prevent potential harm if such an activity is undertaken. The approach prescribes demonstration that harm is unlikely or will be mitigated and places upon the proposer of the activity the burden of the financial responsibility for restoration if unanticipated harm does occur. Aquaculture development must therefore address concerns regarding the potential for a wide range of environmental impacts. Alternative types of aquaculture design that are inherently compatible with the natural system would be preferred under the precautionary approach. Examples include, among others: restricting culture organisms to native strains of native species; controlling culture density to minimize stress and disease susceptibility; growing feed organisms to reduce or eliminate the need for supplemental feed containing wild-caught fish meal; and polyculture (the cultivation of several species in one facility) of species that interact to reduce impacts on the natural ecosystem. Polyculture, for instance, may incorporate seaweed or microalgae to utilize nutrient effluents from fish culture and shellfish to eat particulate organic effluents.

A definition of the Precautionary Approach developed during the deliberations of the U.S. Commission on Ocean Policy (2002-3) provides appropriate guidance for aquaculture:

“The Precautionary Approach is applying judicious and responsible management practices,

based on sound scientific research and analysis, proactively rather than reactively, to ensure the sustainability of ecosystems for the benefit of future as well as current generations. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing action in order to prevent environmental degradation. Each management plan developed using the precautionary approach should include scientific assessment, monitoring, potential for mitigation to reduce environmental risk, and appropriate periodic review of the scientific basis for precautionary restrictions, and the restrictions themselves.”

The Precautionary Approach has also been incorporated as a guiding principle in the FAO Code of Conduct for Responsible Fisheries (FAO 1995, Article 6.5), which further emphasizes the need for action in the face of uncertainty:

“States and sub-regional and regional fisheries management organizations should apply a precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment, taking account of the best scientific evidence available. The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment”

Though its primary focus is wild fisheries, the Code includes aquaculture as a special fisheries activity (Article 9), and in so doing prescribes the application of the precautionary approach to this activity. NOAA has drafted a code of conduct for offshore aquaculture that mirrors the concerns and approach of the FAO guidelines. Effectively applying a precautionary approach to aquaculture development, both coastal and offshore, benefits the environment, the aquaculture industry, affected activities such as fishing, nearby coastal communities, and consumers. It also fulfills commitments in international agreements to which the United States is party and is consistent with applicable U.S. laws. To accomplish this goal, the management of aquaculture development in federal waters will necessarily be cautious, given the substantial uncertainties involved. This would argue for careful attention to design, initial restrictiveness in permits, and well-developed response

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plans in the case of unanticipated negative impacts.

Environmental Carrying Capacity

As defined in GESAMP (2001), environmental capacity or assimilative capacity is: “a property of the environment and its ability to accommodate a particular activity or rate of an activity...without unacceptable impact.” Some causes and mechanisms of impact can be identified for particular proposed activities in specified locations, and the capacity of the environment to absorb each of these can to some extent be estimated, but there will be uncertainties associated with these estimates. Assessment of environmental capacity for marine ecosystems may include such considerations as: the rate at which nutrients can be added without triggering eutrophication; the rate of organic flux to the benthos without major disruption to natural benthic processes; and increases in the rate of dissolved oxygen uptake that can be accommodated without causing mortality of the indigenous biota (GESAMP 1996a). Understanding and measuring environmental capacity enables prediction of the scale of activity that can be accommodated without threatening to violate environmental standards. The estimate of environmental capacity, however, is invariably associated with considerable uncertainty, so the precautionary approach demands appropriate safeguards. In particular, management of size, stocking density, and fallowing policies can reduce the risk of exceeding the capacity of the ecosystem to support aquaculture while maintaining its own characteristic functions and diversity.

Environmental Assessment and Monitoring

Every area proposed for aquaculture development and every specific proposed aquaculture project is to be subject to an Environmental Assessment or Environmental Impact Statement as required by NEPA. In the process all scientific information available on the site and project should be assembled and additional information gathered if necessary. Before the project may move forward, an environmental baseline study of the area or site should be done. The surrounding aquatic and benthic ecosystem should be characterized biologically, physically, and chemically and potential impacts should be identified. The risk of unacceptable impacts

and the opportunities to mitigate negative impacts should be assessed. However, it is important to understand that risk assessment alone will not provide enough information upon which to base a decision, because some potential impacts will be unforeseen. There will ultimately have to be some provision for dealing with such impacts.

For each approved project, critical environmental parameters should be identified for regular monitoring (for example, sedimentation, oxygen levels and BOD, nitrogen concentrations, and indicator species). The Monitoring Plan should be available when the EIS or EA is reviewed. There should be plans for frequent analysis of monitoring data.

Adaptive Management

Integral to the application of the precautionary approach is *adaptive management*, which is sensitive to monitoring and enables rapid response to unexpected environmental impacts. Management plans for aquaculture ventures should provide for adequate monitoring and mechanisms for responding in a timely fashion if monitoring results indicate unacceptable changes in the ecosystem which could be caused by the aquaculture operation. Because of inherent ecological complexity and the difficulties associated with monitoring complex ecosystems, it will not always be possible to prove cause and effect. Therefore, the flexibility to appropriately modify operations when suspected negative impacts are detected is key to avoiding or minimizing environmental damage. Adaptive management also affords the critical opportunity to apply lessons learned to future management decisions, thus providing for the improvement of offshore aquaculture management over time.

Public Participation and Transparency

Including the public in the environmental reviews at each of the stages discussed above is fundamental to U.S. law and to international codes of conduct for aquaculture. Federal waters are public waters, and therefore the public must be fully informed and involved in the permit/lease process, and be given adequate and understandable information of the benefits and environmental impacts of individual proposed aquaculture projects. All analyses relevant to environmental assessments and monitoring should be well documented and

made public. Furthermore, with little knowledge about the environmental effects of offshore aquaculture, either negative or positive, it is in the public interest for the government to support research relevant to the environmental effects of various technologies and methods associated with commercial aquaculture in federal waters.

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Recommendation 5.4

Every environmental review should incorporate public (including stakeholders) review. Public input should be solicited and

integrated into the process so that it can effectively influence decisions based on the environmental reviews.

While regulations and permitting authorities generally emphasize the need to minimize negative environmental impacts, it is important in the case of aquaculture that environmental review and permitting procedures also consider positive impacts. Indeed, giving credit in some way for those positive effects will provide incentives for more beneficial types of aquaculture.

POTENTIAL EFFECTS OF AQUACULTURE IN FEDERAL WATERS

Aquaculture practices in marine waters can generate environmental impacts as a function of: (1) the applied technique; (2) site location; (3) size of the production; and (4) capacity of the receiving body of water (Ackefors and Sodergren 1985), as well as (5) the selection of species and genetic strains. Aquaculture may affect water quality, the benthic layer, the native gene pool, the spread of disease, and the ecosystem as a whole. As particular considerations and issues are site- and species-specific, anticipated and actual impacts will have to be assessed on a case-by-case basis. Furthermore, assessments of environmental impact need to be made at several stages in the process of planning, permitting, and executing aquaculture development.

The nature and intensity of all the offshore aquaculture impacts cannot be predicted at present due to the limited experience thus far within the industry. Though the effects of nutrient-rich wastes might be diminished by greater and more rapid dilution in the open ocean, one might expect that many of the issues associated with coastal aquaculture will confront open ocean aquaculture as well (see *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone*). The most important potential effects include those noted below.

Exceeding the Capacity of the Ecosystem

The estimation of “carrying capacity” is complex and typically associated with high levels of uncertainty. In the case of aquaculture, it is based upon the ecosystem’s potential to support the cultivated organisms and process the effluents while successfully maintaining the diversity and productivity of the natural biological system. In other words, aquaculture should not sacrifice ecological integrity and the health of wildlife. When the carrying capacity is exceeded, degradation of the ecosystem begins, generally resulting in reduced ecosystem structures that are more vulnerable to collapse. Even in large and dynamic marine ecosystems, the number and size of aquaculture facilities in a given area as well as the nature and quantity of their effluents are critical in determining whether the system can support the activity.

Pollution Due to Waste Flowing from Net Pens or Other Aquaculture Structures

Wastes potentially associated with aquaculture facilities open to natural waters offshore will include urine (nitrogenous wastes), feces (highly organic wastes), feed fall-out, pharmaceuticals, growth-enhancing chemicals, and antifoulant chemicals. Densely stocked

ENVIRONMENTAL REVIEW

fish of the expansive culture facilities expected in federal waters could discharge very large amounts of excrement, feed, and associated chemicals. Depending on local conditions, such as currents and ocean depth, these substances could have detrimental impacts on the ecosystem and/or the culture system. Most shellfish are of less concern, due to the relatively low nutrient content of their pseudofeces (compared to fish excrement), and they often do not require extra feed beyond the naturally occurring plankton. Nevertheless, on the scales and densities expected for offshore shellfish aquaculture, effects such as increased oxygen demand and bottom sedimentation may be of concern and should be assessed. Based upon experience from large, nearshore aquaculture facilities, the consequences of pollution generally fall into three categories:

- (1) Water quality changes. The addition of nutrients could change natural food web dynamics, lead to localized oxygen depletion, or be toxic to marine life (including the cultured species). Nutrient enrichment resulting from feed debris and excrement, may or may not be a detriment, depending on natural dilution rates and the capacity of the primary producers to utilize the nutrients without dramatic or unacceptable changes in productivity and diversity. Effluents may include other chemicals, such as pesticides and pharmaceuticals used in association with the treatment of cultured animals or their cages. Assessment of these effluent components and their impacts offshore may be difficult, and setting standards for effluents and the receiving waters may be somewhat arbitrary in highly dynamic offshore waters. Furthermore, even with established concentration guidelines, the monitoring of sources and fates proves difficult in open-ocean situations, and mitigating effects of current flow and dilution are uncertain. An alternative and more precautionary approach is to set targets for the minimization of pollutants, known to reduce environmental quality (GESAMP 1996b) even in the absence of demonstrated harm. Studies of salmon net-pen aquaculture in the Pacific Northwest have shown that risks to water column quality may be relatively low except in poorly flushed embayments and that monitoring sediment quality changes may be more important (Brooks and Mahnken 2003).
- (2) Sediment quality changes. The settling of organic debris and excrement from aquaculture op-

erations may smother benthic communities and/or deplete them of oxygen, thereby creating an inhospitable area beneath the aquaculture cages. As the depth of water beneath the cages increases, the impacts are reduced, if the water circulation in the area is adequate to disperse the debris. Nevertheless, for facilities on the scale expected in federal waters, close attention must be paid to benthic impacts.

- (3) Habitat degradation. Changes in the chemistry or the physical character of the surrounding environment may make the habitat unsuitable for the area's natural biota. For instance, aquaculture may cause changes in oxygen levels, dissolved and particulate organics, inorganic chemical ratios, water clarity, etc. These altered levels may, in turn, lead to changes in biodiversity and/or productivity, potentially jeopardizing the integrity of the surrounding ecosystem.

Interactions Between Wild Populations and Escaped Aquaculture Organisms

In the case of the culture of species that are native to the waters in which aquaculture occurs, escaped aquaculture organisms may interbreed with wild individuals of the same species and cause a shift in the wild gene pool, particularly if non-native strains of native species are used in culture. Non-native species, while not interbreeding with native wildlife, may establish viable reproducing populations in ecosystems into which they are released. Whether aquaculture organisms are native or non-native, escapees may compete with wildlife for food and habitat. All these concerns prove significant, because escapes from aquaculture facilities sited in open waters commonly occur and usually involve very large numbers of animals (Firestone, J. and R. Barber 2003).

While it is agreed that escapes of both native and non-native species should be avoided, there is a great deal of disagreement as to how this goal for aquaculture may best be accomplished. Some believe that facilities can be made secure enough to prevent escapes, that genetically modified organisms (GMOs) can be effectively made sterile or otherwise prevented from surviving in the wild, and that non-native strains of native species are insignificant threats. In contrast, others strongly believe that non-native species, and in some cases non-native strains, and GMOs should be prohib-

ited from open water aquaculture altogether. Before proposals for the introduction of non-native species or strains or genetically modified strains are entertained for offshore aquaculture, Congress or responsible Federal agencies, with advice from the public, must decide whether the United States is going to allow non-native species/strains to be cultivated in federal waters and, if so, what the standards for such introductions will be.

If the government is inclined to consider allowing the cultivation of non-native species or strains when there are assurances of containment, it is essential that, at a minimum, a formal Environmental Impact Statement be produced consistent with NEPA and with full public participation and review. The EIS should consider the risk of non-containment and the potential impact on the ecosystem if the species is not contained. It is important to note that in their codes of conduct, FAO and ICES have assumed that culture organisms will escape from their enclosures and have indicated that regulatory criteria should be based on this assumption. For the purposes of this report, international guidelines will be cited, but it is critical that the United States develop its own standards, with input from the public (those who have ultimate authority over these waters).

Introduction of Non-indigenous Species and Diseases

Little disagreement occurs over the need to avoid the introduction and establishment of non-native species into the ecosystem. Aquaculture in open waters should generally avoid species that would be outside their recognized range, at least until standards have been developed as described in the previous section. This framework for aquaculture in federal waters was developed for the aquaculture of native species.

Open to exchange with ocean waters, offshore aquaculture structures pose the potential for releasing large quantities of cultured and associated organisms into the natural ecosystem. The release of culture organisms and/or any diseases they harbor, may occur as releases of minute reproductive stages of the culture organism, escapes of adults with or without disease, and/or the transmittal of disease microbes to nearby wildlife. The concern is that cultured species or strains that are not characteristic of the local biological community may escape and survive to interact with wildlife, and may reproduce and establish populations in ecosystems not within their natural distribution range.

New diseases may be transferred to native biota, or, conversely, disease from the wild may pose a threat to culture organisms. If such is the case, the aquaculture facility may become a concentrator of naturally-occurring diseases in the ecosystem. The avoidance or treatment of disease in aquaculture facilities may involve antibiotic drugs, which themselves can become an environmental problem. For that reason, vaccines are favored whenever possible.

Impacts on Fish Habitat and Interactions with Fisheries

While ecologists are concerned about the impacts of aquaculture on whole ecosystems, the fishing industry is concerned about the potential impacts upon fished stocks. Large-scale aquaculture may impact nearby habitat of fished species and thereby affect their availability to the fishery. Areas essential to the survival and reproduction of important commercial fisheries species should be avoided when siting aquaculture facilities.

Offshore aquaculture has the potential to interfere with fisheries in several ways. The location of the facilities in traditional fishing grounds can give rise to conflicts. With some forethought regarding siting, many such conflicts are avoidable. Other interactions may be more complicated. If the aquaculture effluents damage nearby critical fish habitat, cause toxic algal blooms, or spread disease to wild fish populations — or if escaped aquaculture fish interbreed or compete with wild fish — fisheries may be adversely affected, although specific linkages are difficult to prove.

Interactions with Predatory Marine Mammals, Birds, and Endangered Species

Marine aquaculture facilities attract predatory animals, including mammals (especially seals) and marine birds, attracted by the feed and the culture organisms. Efforts to ward off these animals through a variety of methods, including killing them or driving them away with acoustic devices, require permits under laws protecting threatened and endangered species, and marine mammals. Even with the required permits, these efforts often engender public concern about the welfare of the wildlife.

Impacts Due to Input of Feed

Intensive aquaculture of finfish requires the input of feed, which typically consists of a high proportion of meal and oil derived from wild fish caught specifically for this purpose. While agriculture consumes the greatest portion of wild-caught fish meal, aquaculture promises to increase its share, particularly as the offshore industry develops. The impacts of this increased demand will be felt in marine ecosystems where feed fisheries abound. This transfer from the fished ecosystem

to the aquaculture ecosystem may cause large changes in both marine food webs and distribution patterns on a global scale. There have been attempts to reduce the proportion of wild-caught fish meal by incorporating more material from high-protein plants such as soy, but such efforts may affect the quality of the product and may increase waste from feeding. For offshore aquaculture to be truly sustainable, feed, from whatever the source, should also be sustainably obtained and applied.

EVALUATING AND MITIGATING POTENTIAL NEGATIVE IMPACTS

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Recommendation 5.5

Environmental review should be carried out at three stages of offshore aquaculture development and operation: planning/assessment, leasing/permitting, and long-term monitoring with adaptive management. The respective environmental reviews should be tailored to each stage of offshore aquaculture development and operation.

Environmental assessments/impact statements that evaluate the potential for environmental impacts at each stage may build upon each other, but it is expected that full assessments of appropriate parameters be made at each stage. Pre-established criteria should be developed for zoning, leasing, and permitting decisions, addressing potential impacts on both the natural environment and the human environment (for example, impacts on other ocean users) based upon the precautionary approach. In addition, once an aquaculture facility has been established in federal waters, environmental effects should be monitored and reviewed at pre-determined intervals.

The environmental review process should place highest value on aquaculture systems that promote biological diversity and maintain ecological integrity of the surrounding and underlying ocean environment. Environmental review should ensure that the siting of the facil-

ity is environmentally appropriate and that the proposed aquaculture operation has incorporated all the design and mitigation options necessary to avoid predictable adverse impacts. There are a number of choices to be made in the establishment of offshore aquaculture, and these choices may significantly affect the impacts that a particular facility, group of facilities, and/or aquaculture as a whole will have upon marine ecosystems.

Siting

Arguably the most important consideration in minimizing negative impacts of aquaculture is the decision on the facility location. Siting should take into consideration, for instance, conflicting uses including fishing, water quality needs for the area, current flow patterns, storm patterns, and proximity to areas important to threatened and endangered species. Each site will have its particular concerns, and thus the complement of parameters needed for assessment will be site-specific.

Facility Design

In the design of the facility, containment to minimize escapes is of prime importance as well as the entrapment or rapid recapture of culture organisms if they do escape. Other desirable features would include technologies permitting the capture and reprocessing of organic wastes as well as the prevention of toxic effluents. Furthermore, predator control measures should be benign.

Stock Character and Density

Species selection should be based on the need to minimize negative environmental impacts and interactions with wild populations. Stringent adherence to guidelines or standards regulating the use of non-native species or strains should be employed. The density of stocking, furthermore, should neither exceed the carrying capacity of the ecosystem nor threaten the health and welfare of the stocks. Generally, attention to these concerns will also benefit the quality of the cultivated food product. Aquaculture development in large marine ecosystems should favor diversity among species grown in neighboring facilities over repetition (for example, numerous facilities all growing the same single species). This practice is essential to reduce cumulative impacts on the ecosystem and to reduce susceptibility of the cultured stocks to the spread of disease from one facility to another.

Feed Characteristics

Physical characteristics and feeding schedules should minimize waste; natural or cultivated feed is preferable. The use of fish-meal from wild-caught fisheries targeting feed fish should be minimized or eliminated. The use of agriculture products in feed should take into account mass balance of nutrients cycling through the ecosystem (for example, whether or not the system can tolerate the extra load of nutrients from land-grown sources). Aquaculture cultivated food sources are preferable when feed must be added to the system. Discard from fisheries could be used but should not serve as a justification for fisheries bycatch.

Disease Management

Minimization of the use of drugs is strongly endorsed. Vaccines are in all cases preferable to antibiotics and pesticides when there is a choice. In cases calling for antibiotics and pesticides to prevent the spread of disease or parasites, they should be used sparingly and monitored closely. The FDA and EPA are responsible for regulating the use of these chemicals for treating diseases and pests, but their effects on wildlife should be considered by the aquaculture permitting and management agencies as well. When an outbreak of dis-

ease occurs in aquaculture facilities, it must be dealt with in a manner commensurate with the potential risk to wild populations and to other aquaculture facilities. In some cases (for example, infectious salmon anemia (ISA) in salmon farms), this response to disease outbreak may require the immediate destruction of all diseased and exposed stock as well as the fallowing of the facility for at least one year until monitoring indicates the absence of the disease. In other cases, it may be determined that aquaculture organisms with naturally occurring diseases do not elevate the threat of an outbreak in wild populations. Disease outbreaks must be reported immediately to the regulating authority and a designated pathologist, who should make a rapid decision regarding appropriate action.

Integrated Multi-species Aquaculture (Polyculture)

The government should promote research and incentives to encourage polyculture of a variety of species that, when functionally integrated, can mitigate negative impacts and maximize positive environmental effects. In addition to balancing the aquaculture system so that its negative impacts are minimized, well designed and executed polyculture provides diversity that should contribute to the stability of the culture system as well as to the maintenance of the natural ecosystem. It may also eliminate the need for the input of feed from external sources.

Biosecurity

Biosecurity refers to producing aquatic species in a well-controlled environment that excludes the introduction or propagation of unwanted organisms and includes the prevention of escape or passage of organisms back into the natural environment (Moss 1998). The use of “specific pathogen free” animals, a mandatory starting point for such a system, ensures the reliable identification and propagation of animals that are free of listed pathogens. In this sense, biosecurity encompasses not only animal health, but also the design, location, and operation of the production systems, as well as product quality, product safety, and environmental and economic aspects.

NATIONAL LAWS AND INTERNATIONAL GUIDANCE

U.S. Laws and Regulations

Environmental review at each stage of aquaculture development in federal waters should be consistent with applicable U.S. laws and regulations, which are discussed under relevant sections in this document. As mentioned previously, NEPA, the law that addresses environmental review directly, requires an Environmental Assessment (EA) for any proposed activity that has a potential environmental impact. The EA is used to determine the potential for significant environmental effects, which, if found, warrant a full Environmental Impact Statement (EIS) prior to granting any federal permit(s). While NEPA establishes the general process of environmental assessment, requirements of other applicable statutes provide additional guidance for evaluations to be included in the EAs and EISs and for decisions based on these evaluations. The applicability of NEPA to aquaculture in federal waters seems clear but should be reaffirmed to prevent attempts to discount it. Other applicable laws are reviewed in other sections of this document.

International Guidance

Three international institutions have developed aquaculture guidelines, which prove useful in establishing criteria for the environment review processes with respect to aquaculture in federal waters. These criteria are found in: the UN Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries; the GESAMP report on Planning and Management for Sustainable Coastal Aquaculture Development; and resolutions of the North Atlantic Salmon Conservation Organization (NASCO), especially the Oslo resolution to minimize impacts from salmon aquaculture on wild salmon stocks. These international agreements set minimal standards with which U.S. procedures should comply. For many provisions, U.S. standards may be more stringent and precise. The environmental guidelines relevant to aquaculture for these three organizations are compared in Table 5.1.

RESPONSIBILITIES OF GOVERNMENT AND INDUSTRY

Offshore aquaculture is an expensive undertaking. Thoughtful design and implementation prove costly but essential, as do the activities of management and environmental review. Monitoring the environmental impacts of aquaculture will require extensive baseline data and follow-up measurements of biological parameters not specifically regulated. The monitoring plan should be developed by the responsible government office (NOAA Office of Offshore Aquaculture if established) and should be comprehensive in scope to enable the assessment of regional ecosystem impacts. The benefits of baseline data will be shared by the public, the scientific community, and the aquaculture industry alike. Therefore it is appropriate that at least initially when the offshore industry is relatively small, the government share the costs of baseline monitoring with industry. This is distinct from operational monitoring associated with compliance, the cost of which should be borne by industry as part of the cost of conducting business, and in line with the polluter pays principle. It is accordingly recommended that:

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Recommendation 5.6

Initial environmental review and associated ecosystem monitoring should be done by or under the direction of the NOAA Office of Offshore Aquaculture, with costs shared (especially initially) by NOAA and the applicant. Costs of subsequent monitoring associated with comprehensive environmental review could also be shared while costs for routine operational monitoring should be borne by industry.

Table 5.1 International Environmental Guidelines Applicable to Offshore Aquaculture Development

	FAO Code of Conduct for Responsible Fisheries	GESAMP Planning & Management for Sustainable Coastal Aquaculture Development	North Atlantic Salmon Conservation Organization
Application of the precautionary approach	x	x	x
Minimize adverse effects on wild fishery populations and critical fish habitats	x		x
Adopt and implement international codes of practice for introductions and transfers	x		x
Planning should ensure aquaculture development : is ecologically sustainable ensures rational use of resources ensures access to fishing grounds protects local livelihoods	x x x x	x x	
Base environmental review on best scientific information available, taking into account traditional knowledge and relevant environmental, economic and social factors.	x		
Appropriate brood stock selection and production of eggs, larvae and fry	x		x
Advanced environmental assessment of potential and actual impacts: on wild species diversity on genetic diversity of wild populations on critical habitat on ecosystem integrity on harmful algal blooms on water quality by interactions with wild populations by discharge of nutrient and organic effluents by use of drugs and chemicals by inputs (feeds etc.) with respect to environmental capacity	x x x x x x x	 x x x x x x x	x x x
Ensure: responsible choice of species or strains responsible siting aquaculture exclusion in defined critical habitat responsible design and technology responsible management by fish farmers responsible spatial distribution of facilities appropriate density of culture organisms minimization of escapes	x x x x	 x x x x x x	x x x x
Minimize harmful effects of introduced non-native species, genetically altered organisms, and disease	x		x
Develop and use appropriate feeds, feed additives and fertilizers	x		
Effective farm and fish health management: enforce hygienic measures favor vaccines minimize pharmaceuticals prevention/minimization of spread of disease fallowing sites maintain disease lists	x x x x	x x	x x x x
Minimize /regulate use of hazardous chemicals	x		
Ensure food safety and high quality of product	x		

SUMMARY OF ENVIRONMENTAL REVIEW RECOMMENDATIONS

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Recommendation 5.1

Congress should clarify and confirm that NEPA applies to federal waters and the continental shelf.

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Recommendation 5.2

Environmental impacts from aquaculture, such as those described in this chapter, should be avoided, minimized, or mitigated to the maximum extent possible.

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Recommendation 5.3

A commitment to sustainability, application of the precautionary approach, concern for environmental carrying capacity, thorough scientific assessment and monitoring of the environment, ecosystem-based adaptive management, and public participation and transparency should guide environmental review of aquaculture in federal waters.

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Recommendation 5.4

Every environmental review should incorporate public (including stakeholders) review. Public input should be solicited and integrated into the process so that it can effectively influence decisions based on the environmental reviews.

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Recommendation 5.5

Environmental review should be carried out at three stages of offshore aquaculture development and operation: planning/assessment, leasing/permitting, and long-term monitoring with adaptive management. The respective environmental reviews should be tailored to each stage of offshore aquaculture development and operation.

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associated with comprehensive environmental review could also be shared while costs for routine operational monitoring should be borne by industry.

CHAPTER

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MONITORING OF FACILITY OPERATIONS FOR OFFSHORE AQUACULTURE

THE CONTEXT

Considerable logistical and resource challenges surround the monitoring and inspection of aquaculture farms in federal waters. Monitoring should be coordinated by the NOAA Office of Offshore Aquaculture or through MOUs, MOAs, or other agreements with other federal or state agencies or their designees. With approval, some sampling can best be done through self-monitoring by the farm operator or through a suitable independent contractor, hired by the operator. After a baseline study, monitoring may be carried out to determine site sensitivity, to inform the decision-making process, and to match permit conditions to the environment's carrying capacity. Monitoring may additionally be carried out to:

- Ensure compliance with permit stipulations;
- Verify and validate mathematical models;
- Ensure compliance with environmental standards;
- Measure effects on the environment;
- Determine action to be taken; and
- Audit the results of self-monitoring (SEPA 1998).

It is important to recognize that monitoring is not the sole or best way to prevent environmental impacts from aquaculture. In some countries, environmental assessment has failed to address the problem of over-rapid and unplanned development of aquaculture. The impacts associated with aquaculture are often insignificant when a single farm is considered in isolation but

proper planning must take into account cumulative impacts when several farms are located in proximity. More importantly, in the absence of any broadly accepted environmental quality standards, assessments of the significance of impacts will be highly subjective and inconsistent (GESAMP 2001).

Coordination of Monitoring Activities

The NOAA Office of Offshore Aquaculture should coordinate the data collection efforts of any state or federal agencies that regulate or assist the aquaculture industry. It should also consolidate any data collected by independent monitoring firms or aquaculture firms as part of a permit requirement. All pertinent regulatory agencies should cooperate with the NOAA Office of Offshore Aquaculture in the establishment of a central information system and should provide all available information requested. The NOAA Office of Offshore Aquaculture will work with industry to determine data that should be public and data that can remain confidential.

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Recommendation 6.1

The NOAA Office of Offshore Aquaculture (OOA) should coordinate data collection efforts of state or federal agencies that regulate or assist the offshore aquaculture

industry. The NOAA OOA should establish MOUs, MOAs, or other agreements with pertinent regulatory agencies to ensure that these data are supplied in a timely fashion and in a proper format to avoid duplication of effort.

In order to obtain agreement on any specific response or adaptation of the Monitoring Plan, monitoring must include effective synthesis, analysis, reporting, and effective communication of monitored parameters and variables. Reporting procedures and response mechanisms, furthermore, must be clearly spelled out in the plan.

Monitoring Costs

Industry should bear the costs of operational monitoring. Given the number of unknowns and variables inherent in the offshore environment, it will be imperative to perform extensive baseline data collection. The costs of this initial data collection will be substantial and beyond an industry that is in the early stages of development. In order for the aquaculture industry to develop in offshore waters, federal authorities will have to perform and pay for at least some of this work. As the industry develops and some of the unknowns are clarified, then the offshore aquaculture industry should assume more of even the baseline monitoring costs.

TYPES OF DATA AND MONITORING

Baseline data should be collected and organized in such a manner as to allow effective enforcement of all laws pertaining to aquaculture at individual facilities. Baseline features should be established before the permits are granted and should include, at a minimum, the following site-specific categories:

- Geophysical site characteristics, including currents and bathymetry;
- Benthic habitat characteristics including community structure and function; and
- Water column water chemistry and plankton.

A monitoring program may collect information for outcome indicators or performance indicators. Indicators relating to specific objectives of the management plan (for example, environmental quality; biodiversity; productivity; economic activity) are known as outcome indicators. Indicators relating to the efficiency or effectiveness of the planning procedures, or to the performance of individual components and implementing mechanisms of the plan, are known as performance indicators. The outcome indicators should serve not only to measure success in meeting objectives, but also to enhance understanding of physical, ecological, and

economic systems, and of the causal links between development activity and environmental effects (GESAMP 2001).

Operational Monitoring or Permit Compliance Monitoring

If the NOAA Office of Offshore Aquaculture determines that a proposed aquaculture activity does not have a significant environmental impact, it may issue a finding of no significant effect (FONSI) and reduce the frequency of monitoring or the types of data that it requires. The NOAA Office of Offshore Aquaculture should have the authority to require monitoring of any of the following as a requirement of the lease/permit:

- Feeding and production data sufficient to estimate effluent loading;
- Changes in water column chemistry or phytoplankton composition;
- Changes in benthic habitat characteristics, including community structure and function or sediment organic composition;

- Smolt and brood stock introduction and transfer data;
- Disease incidence and use of chemical therapeutics; and
- Other such ancillary information as may be necessary depending on the nature of the production facility.

Analysis

Collection and organization of data should be done in such a manner as to allow effective enforcement of all laws and regulations pertaining to the aquaculture activities. Data returns should be promptly entered into a database and compared to levels established in the aquaculture permit. If appropriate levels or standards are exceeded, then prompt remedial and enforcement action should be initiated by the NOAA Office of Offshore Aquaculture or its designees.

Site Inspections and Audit of Records

Routine inspections of facilities' shore bases to check compliance with aquaculture permit conditions should involve the inspection of: stock records held; medicinal treatments; chemical storage facilities; disposal facilities for mortalities and other solid wastes; net-washing facilities; and the disposal of net-washings. Visits to facilities will be necessary to inspect chemical treatments and to obtain water samples from treated cages for chemical analysis. Samples of fish or shellfish tissue and feed may also be collected. The frequency of these visits may vary depending on the size of the farm and the sensitivity of the site. While some visits will be pre-arranged to ensure the engagement of appropriate farm personnel, others must be unannounced. Further unannounced visits will be undertaken if a breach of permit conditions is suspected.

Discharge Monitoring

Due to difficulties associated with obtaining representative samples, monitoring of seawater for medicines and chemicals following discharge through the cage net is not practical. However, sampling of water within the treated cages may occasionally be warranted in certain circumstances and the measured levels compared against recommended treatment concentrations. Appropriate sampling protocols should be established by the NOAA Office of Offshore Aquaculture in consultation with industry.

Environmental Monitoring

Environmental monitoring can be carried out in order to check compliance with environmental standards or to assess sites or coastal systems for expansion or development. The NOAA Office of Offshore Aquaculture may require the regular collection of biological, chemical or physical data from predetermined locations such that the present status, and any ecological changes attributable to aquaculture, can be quantified (GESAMP 1997).

Self-monitoring

Depending on staff and budgetary considerations, the NOAA Office of Offshore Aquaculture will undoubtedly delegate some of the monitoring duties to the applicant, to independent consultants, or to other regulatory agencies (through MOUs, MOAs, or similar agreements). Self-monitoring relies on operators to carry out an agreed program of work, at an agreed timescale, in agreed formats, at agreed sampling stations, either using their own staff or a contractor. The program must be enforceable, flexible, and site-specific.

The NOAA Office of Offshore Aquaculture should periodically review and audit self-monitoring plans to ensure the soundness and accuracy of the data collected as well as the appropriateness of the sample collection and handling methods. Operations with a track record of little impact should be considered for reducing the frequency of the sampling, as appropriate.

Monitoring Strategies

The scaling of monitoring effort to the sensitivity of the site or coastal system and to the size of farm is recommended (GESAMP 1996). The data must be collected in a robust and scientific manner. Sampling and program design, including monitoring frequency and intensity, should be flexible and will vary depending on key issues and priorities. Monitoring must be regularly reviewed to ensure optimization of resources and feedback into remedial action programs.

The general public, and other stakeholders, should have prompt access to monitoring results. This access will help maintain the participatory dimension of the plan, and encourage responsibility for meeting its objectives.

MONITORING OF FACILITY OPERATIONS

Agents that can cause environmental effects and should require monitoring include:

- Organic wastes from feces and waste feed;
- Nutrients within the water column; and
- Medicines, therapeutants, and chemicals, including antifouling agents.

The types of data collected can include: chemical data, such as concentrations in the water column, sediments and biota; biological data, such as assessments of the invertebrate community of the sediments, bioassay and biomarkers of toxic effects; and physical data, such as information on physical characteristics of sediment and water movements.

Programs of data collection may be designed for:

- Pre-license baseline studies, such as for the determination of site sensitivity;
- Post-license operational monitoring, such as for effects assessment;
- Aquaculture permit compliance, during production, pre-stocking, fallowing or medicines application;
- Assessing site recovery after the removal or reduction of biomass from the farm.

The interpretation of the data depends on an understanding of both the effects arising from fish and shellfish farming and the nature and complexities of the receiving environment. The reasons for obtaining the data will determine the optimal quantity and quality of data required, as well as the environmental compartments to be investigated (for example, water, sediments, and biota.)

Environmental monitoring can be carried out locally and/or regionally around a site, and either on a short term or a long-term basis, depending on the effects under investigation or data under review. Measurements against background reference sites and/or baseline pre-operational /pre-change conditions are essential.

Potential weaknesses and associated risks to be avoided include:

- A failure to analyze and review the data;
- The measurement of inappropriate determinants;

- The collection of data that cannot be interpreted or applied to measurable field effects; and
- Poor feedback into regulatory mechanisms.

Survey Design and Statistical Considerations

When designing a monitoring program, it is necessary to optimize the quantity and quality of data generated with the resources available. The survey design should consider the species to be used. Statistical analysis is fundamental in this respect and should be used to meet the following operational requirements:

- The design of sampling programs;
- The review and analysis of data sets;
- The determination of how to optimize the use of information or resources; and
- The identification of data gaps and the determination of the degree of replication in sampling and analysis required to detect environmental change.

A potentially useful aid to the design of these programs is the “Improved Environmental Monitoring Manual of Best Practice” and accompanying suite of computer software developed by the Scottish Environment Protection Agency (SEPA 1998). The manual separates the design of a monitoring program into logical steps, allowing the statistical evaluation of the performance of the proposed strategy, and, therefore the value of the resulting information. It is then possible to re-evaluate the proposed program by altering assumptions regarding either resources available or acceptable statistical precision, bias, or data reusability. Thus, this manual provides for the design of the optimum monitoring program within the resources available.

Where effects are severe, complex statistical analysis may not be necessary. However, monitoring is of little value if causal links and change cannot be unambiguously established and differentiated from background factors. Statistical approaches to assessing changes from baselines and reference data are necessary (SEPA 1998).

Confidentiality

Information obtained by the NOAA Office of Offshore Aquaculture is a public record, unless it is data voluntarily collected by the submitter and is appropri-

ately designated as being only for the confidential use of the NOAA Office of Offshore Aquaculture or its agents. The NOAA Office of Offshore Aquaculture should establish procedures to ensure the segregation from public records of information so designated. Reasonable mechanisms should be established allowing public persons to request to view such confidential information and the submitter to respond to the request. Without compelling rationale, the NOAA Office of Offshore Aquaculture should not reveal confidential information.

Comparison of Water and Sediment Quality with Standards

Water quality, and in some cases sediment quality, can be evaluated by comparing concentrations of nutrients, medicines and chemicals, and dissolved oxygen levels with established environmental quality standards (EQSs). These EQSs may have different origins and status. Some are derived for and endorsed by the EPA. Certain standards may be described as 'tentative' when a detailed toxicity data set is not available (for example, EPA's Alert Levels for heavy metals in bivalves), and others, which are based on few data, should be referred to as Predicted No Effect Concentrations (PNECs) rather than EQSs.

Environmental quality standards for water can be divided into several categories to cover different forms of pollution and different exposure-period lengths. They may be expressed as an annual average, which may be assessed by samples collected over a long time period and is more applicable to continuously discharged pollutants. Antifouling agents are principally in this cat-

egory. For pollutants that are discharged intermittently (such as sea lice treatments), a shorter term standard or a maximum acceptable concentration is more relevant and can be applied to a single sample. Compliance with standards for sea lice treatments are usually estimated by mathematical modeling rather than by sampling and analysis (SEPA 1998).

Samples may be taken over a wide area (up-current, down-current and across-current) from the site; however, the most elevated concentrations are likely to occur down-current.

The derivation of quality standards for sediments is much more complicated than that for water. The pollutant may be deposited in the surface layer; however it can migrate vertically through the sediment over time, and may also be dispersed by re-suspension. Alternatively, the pollutant may bind to fine or organic sediments and, although it might be measurable chemically, being in a bound form, it may be biologically unavailable and therefore not toxic (MAFF 1995).

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Recommendation 6.2

A paramount objective of monitoring and regulation should be ensuring that offshore aquaculture activities do not exceed established environmental quality standards or the carrying capacity of the environment.

BASIC WATER COLUMN QUALITY INDICATORS

Nutrients

The goal of these policies is to prevent unacceptable, increases in nutrient concentrations, which might result in increased phytoplankton populations and associated water quality problems.

Nutrients arise from fish and shellfish farming through the continuous release of food and feces. There is little evidence that these sources will cause significant problems in offshore waters, but there may be some

risk of elevated concentrations causing enhanced phytoplankton growth in certain basins. The flushing time of the system in relation to primary productivity (plankton production) is important and it is recognized that an area with a flushing time of about 3 days justifies the assessment of planktonic growth. The area requiring monitoring must therefore be defined and will be dependent on its flushing time, depth, and hydrographic characteristics. The flushing time can be calculated from the ratio of tidal volume to total volume (Edwards and Sharples 1986).

MONITORING OF FACILITY OPERATIONS

Monitoring programs for nutrients (nitrogen and phosphorus) and chlorophyll-a levels, should be related to both the biomass of animals and to the sensitivity of the area being monitored. The Scottish Environmental Protection Agency's (SEPA) *Manual of Procedures* for monitoring marine cage fish farming, for example requires nutrient monitoring where the biomass is greater than 1000 tonnes. For farms with a biomass of 1000 tonnes or more, one winter and one summer survey are required; the details of the surveys vary according to the sensitivity of the site (SEPA 1998) (EPA's Effluent Limitations Guidelines apply to facilities producing greater than about 45 tonnes, but do not require water quality monitoring.). Production amounts and other factors (for example the volume and flushing characteristics of the receiving water), will suggest when more or less or any monitoring is required for a particular system.

Data should also be used to assess the effects of local nutrient inputs to the system, and to support the mathematical modeling approach used in setting the conditions of the aquaculture permit. Interpretation of ecosystem nutrient impacts will be difficult where there are other sources of nutrients, such as sewage. We also note recent studies have shown that in most well flushed coastal areas, water quality changes in the water column are often minor and at least one U.S. state has discontinued water column monitoring requirements at salmon farms for NPDES compliance due to such studies (Brooks and Mahnken 2003).

Dissolved Oxygen Monitoring

Deoxygenation may or may not occur locally at a farm, where an organic load is discharged, or in deep basins some distance away. Several farms may contribute to deoxygenation in a basin and thus whole basins should be considered. As for nutrient monitoring, the geographical boundaries of the system must first be defined and the total biomass in the area calculated. To

concentrate monitoring on vulnerable basins, a biomass/sensitivity approach is proposed, as defined by Edwards and Sharples (1986) (SEPA 1998).

It is recognized that deoxygenation is not expected to pose a problem in most offshore environments. Where such a problem exists, the operator would be responsible for dissolved oxygen (DO) monitoring at the site. Some basins may deoxygenate naturally at certain times of year and in such cases, the organic load from farms may exacerbate the degree of deoxygenation. Further research needs to determine production level thresholds when DO monitoring should be required. Modeling techniques may be able to predict how much oxygen depletion a farm would cause within a basin, but such models are not yet fully developed or routinely available (SEPA 1998).

Medicines and Chemicals

Some environmental monitoring may be done, particularly nearby or within cages, but the main method of regulation of the use of medicines and chemicals will be predictive modeling. For each medicine and chemical, monitoring plans will be developed appropriate to the properties and fate of the substance. Monitoring of medicines in water is constrained by the difficulty of relating any water sample to a particular time and distance from the treatment. Routine sampling of medicines in water is therefore not considered to be an effective use of resources. Furthermore, the medicines may be toxic at concentrations below the limit of analytical detection. Water sampling should be used as an occasional check to ensure that modeling predictions are correct, and should focus on the 1-3 hour period after treatment, and within a short distance of the cages. Occasional sampling within the treated cages also proves valuable to check that the concentration does not exceed that recommended on the product label (SEPA 1998).

SEABED MONITORING

Applicants considering various sites should be alerted to the advantages of more dispersive, as opposed to less dispersive, sites for marine farms, so as to reduce the severity of benthic effects from settling effluents. In highly energetic areas material may be dispersed and

assimilated by the benthic fauna, with relatively few effects. In lower energy areas, the seabed may become organically enriched and anoxic, causing distortions in the structure of the benthic fauna.

Unlike some other effects, such as nutrient enrichment, the effects of organic pollution on the seabed are usually localized. Therefore, monitoring should focus on the vicinity of the farm and, for this reason, some seabed monitoring lends itself well to self-monitoring by operators or their consultants. Accumulation rates will vary drastically according to depth of water, current speed, and species present, with some species releasing more organic particulate material than others. Small biomass farms in dispersive areas are unlikely to cause problems and thus a biomass/sensitivity table should be prepared to ensure that the monitoring effort is targeted where the risk is greatest (for example, at sensitive sites with a large biomass) (Edwards and Sharples 1986, SEPA 1998).

Medicines and Chemicals

Sediments will be monitored for medicines and chemicals, which are likely to accumulate, for comparison

with sediment action levels. For in-feed medicines, or other medicines that may accumulate in sediments, regulators should occasionally sample and analyze sediments for residues and compare these with sediment criteria and action levels. For any new substances, appropriate monitoring programs will be introduced, depending on the properties of the substance and the most sensitive environmental compartments (SEPA 1998).

It should be incumbent upon the NOAA Office of Offshore Aquaculture to define appropriate standards for sediment concentrations of chemicals (such as anti-fouling treatments and therapeutants), based on the best available scientific data indicating probabilities of unacceptable impacts to the environment.

In federal waters, defining an area for either water column or seabed impact assessment may be challenging. If environmental capacity can be determined, then the door is opened to controls on effects, rather than on activity.

SUMMARY OF MONITORING RECOMMENDATIONS

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Recommendation 6.1

The NOAA Office of Offshore Aquaculture (OOA) should coordinate data collection efforts of state or federal agencies that regulate or assist the offshore aquaculture industry. The NOAA OOA should establish MOUs, MOAs, or other agreements with pertinent regulatory agencies to ensure that these data are supplied in a timely fashion and in a proper format to avoid duplication of effort.

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Recommendation 6.2

A paramount objective of monitoring and regulation should be ensuring that offshore aquaculture activities do not exceed established environmental quality standards or the carrying capacity of the environment.

CHAPTER

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COMPLIANCE AND ENFORCEMENT FOR OFFSHORE AQUACULTURE

THE CONTEXT

Purpose

The intent of the recommendations in this chapter is to suggest a set of compliance and enforcement mechanisms associated with the aquaculture leases.

Possible Compliance and Enforcement Issues

Certain operations will be prohibited outright (for example, overboard discharge of certain wastes or chemicals). Other operations will be permitted to the extent that they do not cause unacceptable impacts (for example, feeding, harvesting, and net cleaning). At some point certain operations can be expected to have unacceptable repercussions on the environment. To the extent that these impacts can be predicted in advance then operational limits may be appropriate.

Enforcement measures would be taken when aquaculture operations exceed the terms of the aquaculture permit. Operational violations could encompass:

- Violating species, stock sources, strain, disease inspection, or genetics requirements;
- Exceeding stipulated stocking densities or feeding

rates;

- Use of chemicals, antifoulants, parasitides, therapeutants in excess of aquaculture permit;
- Activities or structures outside the physical metes and bounds of the lease;
- Failure to deploy or maintain physical structures according to accepted plans;
- Unacceptable changes in BOD, nitrogen, and/or bottom fauna detected by monitoring;
- Violated escapement provisions;
- Clean Water Act (NPDES if required) violations; and
- Marine mammal interactions.

Protection of aquaculturists might be needed for situations involving:

- Vandalism or theft (willful or unintentional); and
- Collision resulting in accidental damage or injury.

REGULATION

The emphasis on environmental regulations must be to control unacceptable environmental impacts (SEPA 1998). Controlling the scale of the activity does not allow for economic growth and provides a disincentive for technological innovation (GESAMP 2001).

Ideally, regulations will guide, promote and facilitate sustainable development of the aquaculture industry. Ensuring that activities (either alone or in the aggregate) do not exceed the carrying capacity of the environment is one practical interpretation of this objective. Regulations should also observe the precautionary approach (see Ch. 5 for definition) and the polluter pays principle (requiring polluters to pay the costs of monitoring, management, and of clean-up) (GESAMP 2001).

Aquaculture regulations must be coordinated with other state and federal management initiatives, integrated coastal management plans, and fishery management planning efforts. As emphasized in previous sections, public involvement is important, meaning not only consultation and information exchange, but also direct involvement or participation of stakeholders in the decision making process, especially in relation to defining overall objectives and associated targets and standards (GESAMP 2001).

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Recommendation 7.1

The NOAA Office of Offshore Aquaculture should coordinate state and federal management initiatives and incorporate input from both public interests and the offshore aquaculture industry to ensure that no significant compliance and enforcement concerns are being overlooked, while at the same time avoiding unnecessary duplication of effort.

Regulation is difficult, especially with respect to large numbers of small-scale developments, and offers limited incentive for improved environmental performance. It may be made more effective if responsibility for design, implementation and enforcement is located at the proper administrative level, and full use is made of self-management and self-enforcement capacity by industry and farmers' associations. Incentives (financial, market, infrastructure) can be designed to stimulate innovation and improvements in environmental management, and should be used wherever possible. However, incentives may need to be underpinned or reinforced through complementary regulation (GESAMP 2001).

Codes of Conduct

Where the rationale for regulation is clear, and particularly when it relates to the interests of farmers themselves (for example, where it is designed to minimize self pollution, or exchange of pathogens between farms), every effort should be made to promote self-regulation through codes of practice. These codes may be reinforced through peer pressure, and in some cases actually best enforced by associations of farmers themselves (GESAMP 2001).

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Recommendation 7.2

Offshore aquaculture operations should be guided by Codes of Conduct and Best Management Practices developed by industry, regulators, and other stakeholders. The appropriate regulatory agencies should monitor operations to ensure that the Codes and Practices are being followed.

Finally, for regulations to be effective it is critical that the appropriate legal, procedural and institutional frameworks necessary to monitor and regulate the industry are in place and have adequate resources to perform

the task (GESAMP 2001). Regulations need to be rational, motivated by the best available science and not by speculation and emotion. Industry participation in the process will ensure more ready acceptance and easier enforcement, and a flexible, adaptive strategy will ensure that new information can guide the formation of new policy and regulation. Lastly, every attempt should be made to minimize the administrative and financial burden to the industry.

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Recommendation 7.3

It is imperative that the regulatory authorities be given adequate resources to monitor and enforce the offshore aquaculture industry.

Using Environmental Quality Standards as the basis for regulatory interventions

Environmental quality standards (EQS), as defined in the previous chapter, can be used as a basis for regulatory actions in several ways, to:

- Define a specific area or zone in which aquaculture and compatible activities are to be allowed or promoted;
- Set environmental quality standards (EQS) in terms of acceptable nutrient concentrations;
- Estimate environmental capacity (for example, total quantity of nutrients that can be released into the area without breaching EQS);
- Calculate acceptable nutrient loads (the environmental capacity) that will not breach EQS;
- Develop incentives or regulations to prevent aquaculture and other activities from exceeding the acceptable load. (These might include: cessation of permit issuance once a critical total production threshold is reached; cessation of permit issuance once an environmental quality standard is reached; pollution tax related to quantity of discharge.)

Response Procedures

Monitoring of specific environmental indicators is of limited use if it is not linked to a pre-determined management response in the event that the monitored variables are found to lie outside their acceptable limits. There should be a priori agreement about the action that will be taken if, for example, environmental impacts exceed predicted levels. This action might take the form of a reduction (where monitoring indicates that environmental capacity has been exceeded) or increase (where capacity is under-utilized) in, for example, number of farms, allowable waste emissions, stocking density, or production.

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Recommendation 7.4

Regulators must ensure that the operators understand well in advance the penalties associated with any violations and what regulatory actions will be taken if environmental impacts exceed established levels.

Evaluation and Adaptation

It must be recognized that any new plan or regulatory scheme will most likely be inadequate and flawed. Clear procedures must be established for more general evaluation, including subjective assessments, coupled with specific procedures for adapting or changing the regulations and their enforcement. This could take the form of “stakeholder committees”, public meetings or other specified consultation procedures, and possibly periodic evaluations by external consultants. Once again it is clear that these committees must have access to well presented and analyzed monitoring data, as well as more subjective assessments and submissions. They must also have the power to modify the plan as required, on a regular and clearly defined basis (GESAMP 2001).

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Recommendation 7.5

Monitoring results should be promptly reviewed by the appropriate regulatory authority for compliance with lease conditions as well as ecosystem impacts. The NOAA Office of Offshore Aquaculture should coordinate monitoring, data collection and enforcement activities by the various regulatory authorities.

Repeated cycles of assessment, evaluation, and adaptation are required to allow for steady refinement and improved understanding of physical, ecological, social and economic parameters and processes over time and to allow for a steady refinement and improvement of the management plan. Public involvement and expert consultation must be used in the first place to help focus research and data collection. Once the plan is implemented, the need for new research or data, or the redundancy of some research or data, should be assessed, and research and monitoring adapted accordingly

(GESAMP 2001).

It is also likely that certain planning instruments will fail or be inefficient in terms of meeting the objectives of the plan, mandating adjustments or changes. In general it is better to build from modest and widely agreed initiatives and adjust or expand the scope of activities, in the light of thorough evaluation. This approach will allow for much more rapid implementation of the most important elements of the plan.

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Recommendation 7.6

Monitoring requirements and regulations should be flexible and adaptive so that they can respond to changes in operating procedures or environmental conditions. Frequent consultations between industry and regulatory authorities will minimize the monitoring burden and maximize the effectiveness of regulations.

ENFORCEMENT OPTIONS

Penalties

Given the broad range of enforcement issues that may arise, regulatory authorities must be able to apply appropriate civil and criminal penalties against the responsible individuals and entities. Several enforcement options are available when it is determined that procedures defined in an aquaculture permit are not being followed or EQSs are being exceeded.

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Recommendation 7.7

Permit violations should be subject to civil and criminal penalties. If an operation causes damage to the ecosystem, then the operator should be held responsible for remediation and restoration, or, when such

actions are not possible, reasonable costs of such damage.

Civil remedies arise when operations may cause an imminent and substantial endangerment to public health, welfare, safety, or the environment or for violations of the terms of the lease. These remedies could include suspension, revocation, remediation or fines and could be pursued administratively or judicially. Criminal remedies would apply to false statements (for example, forged monitoring results), knowing endangerments (felony), or to gross negligence (misdemeanor).

If monitoring detects unacceptable impacts from aquaculture activities such as chemical discharge, BOD or benthic faunal impacts or escapement, then the operator could be required to:

- Suspend activities;
- Modify the terms and conditions of the aquaculture permit to ameliorate the undesirable impact (for example, reduce stocking densities, feeding rates, move to a more dispersive site or fallow the site);
- Conduct remedial activities to compensate for environmental damages;
- If nothing can be done to avoid the impact and no remedial solutions can be agreed upon, then it may be necessary to revoke the aquaculture permit.

If a violation is detected that does not result in unacceptable environmental impacts, then the regulatory

agencies may choose to re-evaluate the need for such a stipulation in the aquaculture permit.

Where results are satisfactory, no action is necessary except to notify the culturist and to record “no action” in the Public Register. Where results are unsatisfactory, there is a need to inform the farmer and request an explanation. Subsequently, it may be appropriate to move to enforcement action. Alternatively, negotiations on ameliorative options may be more appropriate.

It is appropriate in such cases to give notice of intent to the discharger. This course of action may encourage dischargers to consider other remedial measures.

SUMMARY OF COMPLIANCE AND ENFORCEMENT RECOMMENDATIONS

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Recommendation 7.1

The NOAA Office of Offshore Aquaculture should coordinate state and federal management initiatives and incorporate input from both public interests and the offshore aquaculture industry to ensure that no significant compliance and enforcement concerns are being overlooked, while at the same time avoiding unnecessary duplication of effort.

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About the Authors

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Dr. Cicin-Sain has served as a policy advisor to such entities as the UN's Intergovernmental Oceanographic Commission, World Bank, UN Environment Programme, InterAmerican Development Bank, Canada's Department of Fisheries and Oceans, National Oceanic and Atmospheric Administration (NOAA), Delaware Department of Natural Resources and Environmental Control, and U.S. coastal states and counties. Among her advisory appointments, she has served on the Ocean Studies Board and the Marine Board of the U.S. National Research Council, on the Department of Interior's Scientific Committee on the Outer Continental Shelf, as a senior policy advisor in NOAA's International Program Office, as a scientific advisor to the U.S. Commission on Ocean Policy, and as a policy advisor to the Ship & Ocean Foundation in Japan. Dr. Cicin-Sain served as the Principal Investigator of the current offshore aquaculture study as well as of the earlier 2001 report on offshore aquaculture policy.

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Susan Bunsick currently serves as Policy Analyst with the NOAA Aquaculture Program at the National Marine Fisheries Service headquarters office in Silver Spring, Maryland, but was not working for NOAA when the report was being written. She has a Master

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In 1999, he co-chaired the Organizing Committee and chaired the Program Committee of the "Marine Ornamentals '99", the first international conference on collection, culture and conservation of marine ornamentals. Currently, he is active in organizing "Marine Ornamentals 2006", the fourth in the series, and implementing commercial open ocean aquaculture leasing in Hawaii. He has a Master of Science in Oceanography and is a Certified Fisheries Professional and Urban and Regional Planner. He currently serves on the Board of Directors for the Natural Energy Laboratory of Hawaii Authority and the Center for Tropical and Subtropical Aquaculture. He also is a volunteer facilitator for the Center for Alternative Dispute Resolution and a Professional Member of the World Future Society.

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Rick DeVoe joined the S.C. Sea Grant Consortium in 1980, and has served as its Executive Director since 1997. Mr. DeVoe is a Research Associate of the Belle W. Baruch Institute for Marine Biology and Coastal Research at the University of South Carolina, and Associate Faculty Member of the Graduate Program in Marine Biology and Adjunct Faculty Member with the Marine Environmental Studies Graduate Program at the College of Charleston. He earned degrees from Fairleigh Dickinson University (B.S.), CUNY/City College of New York (M.A.), and the University of Rhode Island (M.M.A.).

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Tim Eichenberg is an environmental attorney and Adjunct Professor of Law based in San Francisco. He has served as legal counsel for the California Coastal Commission, The Ocean Conservancy, Oceana, and the Environmental Defense Center, chaired the Clean Wa-

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John Ewart has been the aquaculture/fisheries extension specialist with the University of Delaware Sea Grant Program at the College of Marine Studies in Lewes, Delaware since 1986. His background includes work as a commercial fisherman, oceanographic technician, field biologist, research associate and laboratory technical coordinator. His professional interests include aquatic production systems/live transport; commercial and recreational fisheries; shellfish restoration and stock enhancement; water quality management; technology transfer and training; aquaculture policy; and Information Technologies.

Mr. Ewart developed and maintains the Delaware Aquaculture Resource Center and Web site that is a member of the Department of Commerce/National Oceanic and Atmospheric Administration (DOC/NOAA) Sea Grant Network of Aquaculture Information Services (NAIS). He is an active member of the World Aquaculture Society, US Aquaculture Society, National Shellfisheries Association and the East coast Shellfish Grower's Association.

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Jeremy Firestone is an Assistant Professor in the College of Marine Studies, University of Delaware. He holds a B.S. in Cellular and Molecular Biology from the University of Michigan, a Juris Doctorate from the University of Michigan Law School, and a Ph.D. in Public Policy Analysis from the University of North Carolina at Chapel Hill. Prior to obtaining his Ph.D., he was an Assistant Attorney General for the State of Michigan working on environmental and natural resource issues for seven years and an Assistant Regional Counsel for the U.S. Environmental Protection Agency for three years. Professor Firestone teaches U.S. Ocean and Coastal Law as well as International Ocean and

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Kristen Fletcher

Following completion of her LL.M., Fletcher joined the Mississippi-Alabama Sea Grant Legal Program at the University of Mississippi School of Law and became Director in 2000. During that time, she advised university researchers, federal and state agencies, and other Sea Grant constituents on ocean and coastal law issues including fisheries law, public trust issues, marine habitat, and offshore aquaculture. She published papers on natural resources, marine and environmental law issues and served as editor of the Water Log Legal Reporter for five years. During her tenure, she led the effort to create the National Sea Grant Law Center and served as its first director when it opened its doors in 2002, overseeing publication of the The SandBar Legal Reporter and Sea Grant Law and Policy Digest and the expansion of services to the 32 Sea Grant College Programs nationwide.

Fletcher became Director of the Marine Affairs Institute, Roger Williams University Law School in October 2003, expanding efforts of the Institute to include legal research opportunities for students and outreach to constituents of the Rhode Island Sea Grant College Program, such as state and federal agencies, policy-makers, and coastal user groups in the New England region. Fletcher will teach Coastal and Ocean Law and Natural Resources Law and assist students enrolled in the Joint Degree Program at the Law School and the University of Rhode Island Department of Marine Affairs.

Recent activities include serving as a fellow with the Environmental Leadership Program and leading a team of scholars which analyzed ocean and coastal laws for the U.S. Commission on Ocean Policy. Fletcher is currently researching issues related to marine protected areas, marine zoning, and fisheries law and policy and

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Harlyn O. Halvorson is the Director for the Policy Center for Marine Biosciences and Technology, at the University of Massachusetts, Boston and Professor Emeritus in the Department of Environmental, Earth & Ocean Sciences and in the Intercampus Graduate School of Marine Sciences and Technology. This center was established in 1992 to address a broad range of problems and opportunities in marine biosciences. He is also Chairman of the Biotechnology Center of Excellence Corporation, Boston. This corporation is continuing the public/private initiatives of the Massachusetts Centers of Excellence Corporation. He has been Chair of the Sea Scallop Working Group in Massachusetts since 1994 and was the past chair of the European Science Foundation Feasibility Study group to develop the EU plan for European Marine Biotechnology. He is co-chair of the pan American Marine Biotechnology Association, and past President of the American Society for Microbiology. He is the founding director of the Rosensteil Center for Biomedical Research, Brandeis University, and an associate editor for both the Journal of Marine Biotechnology and the Journal of Marine Pollution. Other distinctions include: member Advisory Board International Institute for Marine Biology (Sardinia); member Institute of Medicine, American Academy of Arts and Sciences; American Academy for Microbiology; Honorary Member American Society for Microbiology; former President and Director of the Marine Biological Laboratory, Woods Hole, MA; founding President of the National Association of Marine Laboratories; Chairman of the International Committee for the International Marine Biotechnology Conferences; served as co-chair of the Governor of Massachusetts Task Force Subcommittee on Aquaculture: Monitoring and the Environment; Published 320 papers.

Tony MacDonald

Since 1998, Tony MacDonald has been the Executive Director of the Coastal States Organization (CSO). CSO, based in Washington, DC, represents the interests of the Governors of the nation's 35 coastal States, Commonwealths and Territories on coastal and ocean affairs. Mr. MacDonald is a graduate of Middlebury College in Vermont and the Fordham University School

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From 1980 until 1990, Mr. MacDonald held positions with the City of New York as the Deputy General Counsel for the Department of Parks and Recreation, Assistant Corporation Counsel in the Real Estate and Commercial Litigation Divisions of the New York City Law Department, and as the Washington, DC environmental legislative representative for the Mayor Edward I. Koch.

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Ralph Rayburn has been the Associate Director and Extension Program Leader for the Texas Sea Grant College Program since 1999. In that role he manages 15 extension specialists and agents with both thematic and geographic responsibilities as well as assists the director in overall program management. Mr. Rayburn is a graduate of Texas A&M University with a B.S. in Zoology and a M.S. in Biological Oceanography.

Prior to joining the Texas Sea Grant Program, Mr. Rayburn was the Director of Intergovernmental Affairs for the Texas Parks and Wildlife Department for seven years and Director of its Coastal Fisheries Branch for three years. Before his role in state government, Mr. Rayburn spent 12 years as the Executive Director of the Texas Shrimp Association, a trade association for the Gulf of Mexico shrimp industry.

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Robert Rheault

Robert Rheault received his Ph.D. in Biological Oceanography from the University of Rhode Island (URI) in 1995. He has 29 years of experience in various aquaculture positions culturing lobsters, trout, macroalgae, and phytoplankton and has been the president and CEO of Moonstone Oysters in Narragansett, RI for the past 19 years. He is an innovator in shellfish aquaculture technologies and holds a patent on novel shellfish culture gear design.

Rheault is president of the East Coast Shellfish Growers Association, has been an officer of the Ocean State Aquaculture Association for 10 years and is a member of the Board of Directors of the National Aquaculture Association. He is currently an adjunct professor in URI's Fisheries, Aquaculture and Veterinary Sciences Department.

Boyce Thorne-Miller

Boyce Thorne-Miller is a consultant for national and international environmental NGOs. Her background in marine biology has been applied to a variety of marine environmental issues, including toxic and nutrient pollution, marine biodiversity, fisheries, and aquaculture. She has served on government and NGO delegations in international treaties, expert groups, and intergovernmental conferences on ocean issues. She has authored books, chapters, and papers on marine biodiversity and the application of the precautionary principle to international maritime law and fisheries. As an advocate and advisor, she has worked for ecologically sustainable and innovative multi-species aquaculture. She has a M.S. degree in Oceanography from the University of Rhode Island, where she did post-graduate research and published on polyculture of seaweed and fish and on the ecology of RI coastal lagoons.

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Appendix

RESULTS OF CONSULTATIONS WITH NATIONAL AND REGIONAL-LEVEL STAKEHOLDERS

Issue/ Issue Category	Gulf of Mexico September 11, 2002	Northeast Massachusetts September 13 and 17, 2002	National Workshop Washington D.C. September 23-24, 2002	Pacific Hawaii October 3, 2002	West Coast Seattle October 25, 2002
	Administration and Implementation	Office of Offshore Aquaculture			
	<ul style="list-style-type: none"> What role will this agency have? An advocacy for industry role? If so, could be inherent conflict of interest. Or will it just shepherd permit application through other agencies? 	<ul style="list-style-type: none"> NOAA is not a development agency (difficulty in having NOAA the lead agency) If this office is created and not used, could have personnel who want to deal with inshore issues Odds of getting this office authorized in current administration exceedingly remote A tangible effect of having NOAA as the lead agency is that NOAA has biological, chemical, and physical expertise regarding the oceans, all of which are important for marine aquaculture Take out the new office Avoiding the creation of new structures is reasonable (always more difficult to create new offices and to ensure they are funded) 	<ul style="list-style-type: none"> Will it be a program or an in-line office? NOAA looking at establishing a new office to address cross-cutting issues (aquaculture is one of them) Need to make sure this office is not isolated from the parent agency and receives appropriate resources and money. Typically, this type of office has no real authority and doesn't deal with cross-cutting issues This type of office is also typically under-funded Regarding the institutional authority, we need to articulate why we are going with NOAA over MMS, which has leasing experience Concern that this office would only become a project within NOAA An "Office of..." would be better as a line agency. Therefore, it would not be a target, but we still need a highly visible agency What about MOUs between agencies? Perhaps start with a gradation of options: create MOUs, then MOAs, then Office/Lead Agency. Could enable this in the short-term to get the industry going Short-term not a good idea because need to change the law, and thus the responsibilities of MMS/NOAA Worries about the politics of creating new legislation to change the responsibilities of existing agencies 	<ul style="list-style-type: none"> Does NOAA want the aquaculture leasing responsibility? Team should find out if there are any conflicts NOAA should be made an advocate of OA. Could redefine the agency role to be more pro aquaculture NOAA has relevant experience in the EEZ under the Magnuson Act and Sanctuaries Act. Managing leases should be similar. It also has enforcement authority for fisheries (regulatory functions found in line offices). History in advocating aquaculture Protection of lessee rights important in being a landlord. NOAA has civil and criminal penalties for fisheries law violations. Are additional authorities needed? Does the USCG do policing for aquaculture leasing? Should deal with these issues in detail 	<ul style="list-style-type: none"> Most agreed that NOAA has the appropriate expertise and that a single advocate for aquaculture is lacking (USACE not a good fit in this respect). Therefore, some participants supported choosing NOAA over USACE to coordinate permitting. NOAA lease/USACE permit question NOAA as facilitator in permitting. Should be adopted. Alternative - keep separate for credibility One approach is to physically assign someone from USACE to NOAA office On new office: <ul style="list-style-type: none"> Recommend NMFS coordinator and regional coordinator Consider costs Co-location idea Facilitation - NMFS Constituent Services Office Conflict of interest possibility (pro-development mission in agency with environmental stewardship responsibilities) Consultative process/scoping process with NOAA as lead to bring agencies together

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Issue/ Issue Category	Gulf of Mexico September 11, 2002	Northeast Massachusetts September 13 and 17, 2002	National Workshop Washington D.C. September 23-24, 2002	Pacific Hawaii October 3, 2002	West Coast Seattle October 25, 2002
	<div>Existing Structures and Infra-structures/agencies Role of JSA, USACE, MMS, USDA</div>	<div>Administration and Implementation</div> <ul style="list-style-type: none">• NMFS, in conjunction with EPA, USACE, and the New England Fisheries Management Council created guidance and procedures for assessing OA proposals. This information is contained on a single page of paper. NMFS NERO developed a guidance package for aquaculture, based on NEPA objectives. There are more similarities than differences between OA and wind-generated energy (and windfarms occupy more space).• NOAA does not have staff structure that can be redirected toward permitting or leasing sites for aquaculture. Consider the present staff size, mission, funding and regulatory programs in sister agencies. Suggest looking toward USACE and MMS for relevant people, programs, experience, etc. MMS and primarily, USACE, have the staff and experience to permit OA (suggest looking to them).	<ul style="list-style-type: none">• JSA has responsibility to encourage the industry and has a definite role to play in our recommendations and in determining whether current legislation is appropriate or new legislation is necessary• JSA looks at broad issues and is a good model of how things work• USACE role involves area-wide permits for oil and gas (mandated under the OCSLA)• USACE has taken control of windfarms under the Section 10 process (in the case of the Nantucket windfarms)• An aquaculture application should be sent to district offices (not headquarters), where the people are aware of regional issues• USDA is looking at all kinds of aquaculture development (on and offshore, fresh and marine)• MMS is very advanced regarding leasing and permitting; they have a unique perspective, and are very knowledgeable and capable in this area• Issue of mistrust between MMS and environmentalists, though MMS has much permitting/leasing experience• NOAA deals with operational aspects• NOAA has marine experience and good environmental track record• Which agency is most likely to undergo the most change after the Ocean Commission publishes its report?	<ul style="list-style-type: none">• Consult with other federal agencies related to aquaculture for their report comments. Coordinate particularly with EPA's current efforts to develop standards.• Education of the involved agencies and the public concerning OA will be necessary for successful implementation (and also prevention and mitigation of user conflicts).• Through NEPA process, Navy will be engaged in siting• USACE role in aquaculture (i.e. disease management, quarantine) needs to be discussed in report. One person felt USDA should be lead agency for OA leasing• At least one thought USACE should be the lead• USACE permits should be issued at the regional offices (not in D.C.)	<ul style="list-style-type: none">• Separation of leasing and permitting creates duplication, and the USACE is already overworked. Some indicated the USACE may not want permitting responsibility and suggested we directly ask USACE• USDA was chosen as an alternative to NOAA for industry advocacy, since it already plays a role in food production• Participant recommendations included the following regarding roles of other agencies:<ul style="list-style-type: none">- Develop guidelines for cooperating among permit agencies- Clarify role of USCG in marking of aquaculture sites- Define USCG's role and extent of involvement in fisheries and aquaculture enforcement- Identify which agency has jurisdiction over and use of fishmeal• Verify/clarify EPA role in enforcing environmental standards in EEZ• Incorporate FDA in discussion of agency roles• NOAA excludes FW aquaculture; recommend single aquaculture agency for leasing/permitting; FW/SW• USACE too busy now (need resources in both NOAA and USACE (Who pays - start-up)• AK is concerned that NOAA could be taking an advocacy role regarding aquaculture industry. Aquaculture should be subject to same stringent planning requirements as all other FMPs.

Issue/ Issue Category		Gulf of Mexico September 11, 2002	Northeast Massachusetts September 13 and 17, 2002	National Workshop Washington D.C. September 23-24, 2002	Pacific Hawaii October 3, 2002	West Coast Seattle October 25, 2002
Administration and Implementation	Subsidies		<ul style="list-style-type: none"> Private capital will move overseas before dealing with regulatory costs here. The present management plan for fishermen is seeking to reduce their numbers and is succeeding in driving them overseas. US entrepreneurs must compete with other nations that throw millions in subsidies at their industries (Canada) 	<ul style="list-style-type: none"> Consider the role of the government in providing financial assistance for: 1) problems that need addressing; and 2) infrastructure. (Gov't should frontload costs in aqua sector and should invest in the industry to prevent domestic efforts from moving overseas) Separate regulatory roles from promotion and subsidy roles For the OA industry to expand, the government should follow through with new legislation and pay for monitoring The private sector will not be able to deal with financial problems N> gov't assistance in some form needed, though not necessarily in the form of direct subsidies (need a pre-permitting program for areas in the ocean) Consider the broad framework in developing policy for OA 	<ul style="list-style-type: none"> Over-regulating this industry will drive investment overseas. Appropriate regulation needed and politicians should understand the consequences of not developing this industry. 	<ul style="list-style-type: none"> Participants noted that government and industry should share development costs. Suggested that 1% of annual seafood trade deficit be set aside to support EEZ aquaculture development. If the government, however, designates pre-approved sites, it should cover baseline data costs. In establishing monitoring and reporting requirements, government must consider the inherent industry costs
	Regional vs. National and Other Considerations		<ul style="list-style-type: none"> Public trust considerations and energy conservation are very important. In this process, the public must be invited to participate. Projects lacking in redeeming social value should not be authorized 	<ul style="list-style-type: none"> We need to develop direction for aquaculture; it needs some predictability NMFS is concerned that there is no national policy direction (which could branch out to the regions) Are offshore aquaculturists going to be competing with foreign or domestic industries? Is aquaculture within the purview of the Fishery Management Councils (FMC's)? Regarding aquaculture, FMC's are involved in all issues now and have a legislative consultative role, not a regulatory role There has to be either an amendment to FCMA or all new legislation Fisheries limits (i.e., size, weight) are not consistent or applicable to aquaculture 	<ul style="list-style-type: none"> Consider native rights regarding OA, including its impacts nearshore and far offshore Must exceed just the public meeting approach in educating the public on OA 	<ul style="list-style-type: none"> Not clear whether native treaty rights extend into the EEZ. Tribal uses and rights need to be considered. Tribes, as the states, need to be included early on in the process and their preferences should be considered in leasing criteria Need level playing field with environmental costs centered on each part of the industry (i.e. processing) Need someone with mission to make OA work (start with leasing; that's what's missing) FMC model works well Concern: fisheries an extractive model; FMCs promote benefit of fishermen (may be in opposition to aquaculture) FMCs should have jurisdiction in the EEZ and should be consulted regarding whether aquaculture activities should be allowed

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Issue/ Issue Category		Gulf of Mexico September 11, 2002	Northeast Massachusetts September 13 and 17, 2002	National Workshop Washington D.C. September 23-24, 2002	Pacific Hawaii October 3, 2002	West Coast Seattle October 25, 2002
Administration and Implementation	State Involvement			<ul style="list-style-type: none">• In oil and gas:<ul style="list-style-type: none">- What is the time frame to get multiple states to submit a consistency review?- MMS has a phased approach because of resource and impact uncertainty• How do states deal with landing laws? Some states have an aquaculture exemption	<ul style="list-style-type: none">• Affected communities will not accept OA unless they are involved.	<ul style="list-style-type: none">• States need to be involved early on in the process (well before the CZMA consistency review), and their preferences considered in the leasing criteria. Report needs to describe how boundary disputes between state and EEZ jurisdiction over an aquaculture project will be handled• Finfish farming is illegal in AK, and the State opposes net pen aquaculture off the coast• OA operations are subject to state consistency review under the CZMA
	Agency Involvement		<ul style="list-style-type: none">• Windmill-driven electric generation facilities in the EEZ are growing more popular; the processes and procedures are identical to those needed for offshore aquaculture. At present, USACE is the lead. Efforts in NE now will be embraced throughout the US	<ul style="list-style-type: none">• A Memoranda of Agreement and Understanding was done in the 1980s. It was not done specifically in relation to the EEZ, but could be done.• Who can be the point of contact in a process that satisfies all agencies• NOAA could be billed as the lead agency, but would need consultation from MMS• USACE Section 10 permits are limited to construction of structures (limited enforcement capacity N can't enforce antibiotic use)• Need to start out on small scale to collect fees and give assistance	<ul style="list-style-type: none">• Need permitting process that brings in state concerns and interests. The CZM Program appears to be the vehicle (could also be done through CWA)• Can states limit landings of EEZ fish by imposing quotas or other regs (for the protection of local farmers)?	<ul style="list-style-type: none">• CZM Plan:<ul style="list-style-type: none">- CZMA "may affect" language, may preclude aquaculture- Balance - CZMP must look at national interest• General programmatic permits - Corps• Designate aquaculture development zones for improved efficiency• FMCs must be involved• GMOs: critical to consider and evaluate (scientific implications)

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	Permitting and/or Leasing	General	General	General	General
	<ul style="list-style-type: none"> • FL tried the stream-lined approach we're suggesting and abandoned it 	<ul style="list-style-type: none"> • It is agreed that the topic of aquaculture is not specifically covered with procedural protocol, but few activities subject to permitting enjoy such focused attention. It is unlikely, and perhaps unnecessary, for aquaculture to garner special regulatory programming. • Reasonable flexibility in "growing" an OA operation is key for a successful permitting experience. • We should be tweaking the Magnuson Act (and other laws as needed) instead of creating a new structure • Leasing provisions should include: granting exclusive rights to the ownership of cultured species, including shellfish or fish that are "planted" but not confined in those waters (could help community-based initiatives that involve "ranching" of aquatic species. • Look into body of law pertaining to rights & responsibilities of leasing open ocean areas for power generation. Law and CFRs were established for OTEC development in Hawaii (33 CFR Section 99) and could be used as pilot. NOAA was the lead on the topic. 	<ul style="list-style-type: none"> • Clarify: <ul style="list-style-type: none"> - species ownership - the exemption process from FMPs - native species - stock ownership • Need to establish a way to process rights of different user groups (conflicts and equity, multiple-use rights) • What rights will a lease convey? Need to specifically determine these rights • Need to establish a way to increase cooperation amongst related agencies (i.e., MMS has taken over much of USCG inspection responsibilities because MMS has inspectors on-site and more offshore capabilities) • Should a new regime be established for the water column or will a lease on the seafloor extend to the water column • Legislation allows MMS to give rights to other uses after the original ones no longer apply (i.e., after oil operations end, can use facility for aquaculture production) • Should leases be competitive or negotiated, or both? • Will a leasor be leasing the seabed bottom even if he is utilizing the water column? • Solution to leasing agency question might be to state the need for one (don't name who) and wait to see what the OC recommends • We don't want to wait for them; they're waiting for us to give them something • Think about structure of model permit/lease applications 	<ul style="list-style-type: none"> • Team should carefully examine the relationship between maritime law and OA permitting and leasing. What protections for aquaculture exist currently, i.e., if a cage is classified as a vessel? • Why have 2 different agencies for permitting and leasing? Have a single agency for both • Need permitting process that brings in state concerns and interests • One stop permitting strongly encouraged for efficiency (if it replicates or consolidates existing permits) • Most felt that we should issue permits first (to address the siting and environmental concerns), then lease would be issued. • NOAA should not do OA permitting or leasing under Magnuson Act, but have separate authorization. Regional Fisheries Councils need to be consulted in the process • Lease will include requirements for insurance and performance bonds. Could be cumbersome if lease/ permit conditions dictate an uninsurable mooring system • Report should clearly address rights of the farmer when there is a lease (i.e., in the case of vandalism, theft, or multiple-use conflicts) • The aquaculture leasing function, Office of Aquaculture, should be housed in Administrator's Office • A floating aquaculture farm was discussed. Decided it would not need a lease, but would need permits. How would maritime law treat this situation? • Regarding aquaculture projects that don't need exclusivity, a permit could be issued first, with the lease optional. 	<ul style="list-style-type: none"> • Rationale for separating leasing from permitting was questioned • Participants noted the need to coordinate length of permits with length of lease. Otherwise, unnecessary uncertainty created in OA operation (they noted that permits are often renewable at 5-year increments, while leases are 20 years or more) • Participants also pointed out need to specify a start-up time for a project once it gets necessary permits/lease. • Concern about parallel process. After jumping through permitting hoops, may not get lease • Permitting can be attached to lease • MSA exemption? Different types of aquaculture (some take from wild) • National Shellfish Protection Strategy • Adjacent jurisdiction issue - EEZ common resources - collaborative • Specifying species in permit is recommended • STRONG AGREEMENT that applicant should have to prove need for exclusivity • Concern over experimental lease concept (okay for university research) • US ownership only? Is concern over foreign ownership warranted? • Look into priority system set up for salmon eggs • Consider bottom leasing only; tribal and restoration and enhancement aquaculture need to be accommodated • Not appropriate to require business plan (concern over sharing proprietary information)

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Permitting and/ or Leasing	General				<ul style="list-style-type: none"> • Some felt that designating a site via a lease was necessary from a variety of standpoints • Permits should be adaptable to different species and technologies for EEZ • There is at least 1 example in Hawaii where Feds and State did joint planning and EIS work for marine mining activities in the EEZ • Types of leases should be transitional and sequential. Also, include provisions so farmers can easily modify, expand, and diversify on the same site • Types of leases should consider the variety of structures that might be anchored on a farm site • Business plans may not be needed as part of the leasing application. Confidentiality of information is important for companies (need assurance they're safe) • Business plans are a concern. Clarify how extensive a plan will be required. • A lease may not really be necessary to protect public safety and assure sustainability. A cage is a vessel under maritime law with protections that may be sufficient to manage OA without a lease • If exclusive use not needed, why have a lease? 	<ul style="list-style-type: none"> • NOAA right place because Commerce (trade & promotion) above and NMFS (science) below • Equal for public and private sector - don't distinguish (WA State doesn't) • WA State has provisions for small scale experimental lease (LOOK INTO THIS) • Need flexibility/built-in mechanism for ad hoc rules • Volume cap on experimental lease would address concern over "morphing" into L/T lease (Another alternative is a time limit on the experiment) • Need regional model for EEZ • Look at models (EU experience very relevant) • Species (crustaceans, too)

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Leasing	Collection of fees and compensation	<ul style="list-style-type: none"> Many questions on what the lease fees and royalties go toward If the lease does not buy protection from the Coast Guard or other marine enforcement), what are the culturist's rights to protect the cage and fish? 	<ul style="list-style-type: none"> What is the fee charged for a lease if no aquaculture is done? The cost to the public must be evaluated Small companies may be excluded How will we prevent companies from buying and holding too many leases? Reward the entrepreneurs, large and small. Don't want small operations to be at a disadvantage 	<ul style="list-style-type: none"> Crop insurance not really applicable to aquaculture NOAA has a mechanism in place for collecting royalties. It can build a program for leasing with MMS assistance Include "royalties" as a symbol telling outsiders that the "owner" has paid for the right Compensation is good when a large number of firms are interested 	<ul style="list-style-type: none"> Overregulation and over-reporting will kill a fragile new industry. Evaluate the time needed to comply with reporting and permitting. Hard costs, such as legal fees, permit fees, and taxes are only part of the total cost burden of continuing compliance Part of lease rents should return to the states impacted by the projects Costs of rents should not preclude the project from being cost-competitive and economically feasible. Be reasonable regarding agency and farmer needs. Will the federal lease have to go out for bid or will direct lease be allowed? Bidding requirement will be disincetive because applicant with environmental work could get outbid. Should provisions for direct lease be included? Good idea to have rent money from ocean leases go to NOAA to support aquaculture initiatives 	<ul style="list-style-type: none"> Participants noted that rents collected should be put back into EEZ production WA State divides lease revenues and dedicates share to program (i.e.) Include development goals - time limit - in lease. Condition lease on steps being achieved (i.e. CA, lease and authorization are one and the same) Rents - property tax vs. business tax basis Term - 40-50 years based on financing
Planning/ Site Assessment	General	<ul style="list-style-type: none"> Details needed for each site selection option 	<ul style="list-style-type: none"> A pre-permitted site would facilitate the application process, but we cannot foresee every type of aquaculture development Unless MAZ is based on optimal habitat for the grown species, the researcher/grower starts out with a number of natural handicaps 	<ul style="list-style-type: none"> Distinction between pre-permitted (a range of activities including aquaculture) and designated (for aquaculture) Operator would definitely be interested in the process of site designation. 	<ul style="list-style-type: none"> Be cautious about moving forward with the marine aquaculture park concept at this time. Need more knowledge on proper sites and sites. NOAA expertise in finding good aquaculture sites challenged (justify NOAA role). Private sector knows best. Learn from siting mistakes in other countries and in U.S. Discuss in report In current federal budget climate, unrealistic to expect funding for large-scale site assessment. Include in report a mechanism for private sector to find and secure sites 	<ul style="list-style-type: none"> Need to employ entrepreneurial approach, which means siting should be viewed as a process whereby the federal government does preliminary zoning and an applicant proposes what he/she would like to do in the zone. Need to identify use patterns to avoid multiple-use conflicts Protected areas (in HI) can coexist, BUT use common sense, site-specific consideration On restoration - create EFH and harvest ecological value (i.e., Chesapeake) fishery

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Planning/ Site Assessment	General		<ul style="list-style-type: none"> Siting issues are local. We are proceeding from the top down, and should instead be working with the existing EEZ users (fishermen). Will have tremendous resistance otherwise. The proposed framework will prohibit participation by small operators 	<ul style="list-style-type: none"> Database development: Pre-permitted sites are a good idea. Need knowledge or database: GIS technology should be developed to include the depth component of an aquaculture facility (needs a 3-D projection) 	<ul style="list-style-type: none"> In looking for a site, the private sector should be able to draw on public sector resources (information), and should not rely on the public sector to find a site NOAA will probably be required to do Programmatic EIS for this offshore program. 	<ul style="list-style-type: none"> Prioritizing uses: <ul style="list-style-type: none"> - Bring in environmental scientists - Dependence of families in coastal communities and the impact of OA on native fisheries should be #1 priority considerations - Government research - need peer review Pre-permitted sites - get input on AK process for shellfish seeking industry (see legislation and implementation of shellfish leases DOT concept - design/build saves \$\$; additional value re-design government Look at full range of siting items, including socioeconomic; mandatory C/B assessment Industry/public together on this FADs in EEZ & coastal zone What is a "good" site? Study needs to answer this question
	Mapping/ Zoning		<ul style="list-style-type: none"> What aquaculture needs regarding other public trust users is: 1) recognition that you have the exclusive right to be there; and 2) acknowledgement that your actions are not necessarily exclusionary. Every grower should be able to determine where he could place his activity Our basic zoning scheme seems to offer a range of positive advantages. Possibly consider incorporating provisions for rotational management where the zoning restrictions and entitlements could be modified to respond to changing conditions. Aquaculture should be restricted to zones or zones will be meaningless 	<ul style="list-style-type: none"> The technology for mapping and zoning is there. We need to increase information-sharing and coordination between agencies NOAA, MMS, and the USGS have worked on mapping projects Hawaii is currently in the process of GIS mapping, but is having difficulty getting information from some agencies How much of the total water areas is being blocked off and designated as restricted access or no access entirely? 	<ul style="list-style-type: none"> Exclusion mapping is ongoing with military and NOAA sanctuaries and should be used for first approximation of aquaculture sites. Navy has sites that could be excluded. Zoning would be very helpful for the industry's development, especially with regard to locating sensitive/restrictive areas. Also, helpful to locate potential areas on a pilot test basis Location of land-based facilities is very important to fish farming and designating viable farming areas. Buffer zones may be needed between EEZ farmers in close proximity to each other 	<ul style="list-style-type: none"> Examples of mapping: <ul style="list-style-type: none"> - WA study/GIS study in Straits of Juan de Fuca - States, univ, private doing mapping Military restrictions on high-resolution mapping Don't get too boxed in with zoning

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Environmental Review	General	<ul style="list-style-type: none">• Define the precautionary approach/ principle		<ul style="list-style-type: none">• In California, a MMS project occurring before the COUGAR project may contribute additional insights into offshore aquaculture (the state and federal agencies worked together to draft the environmental review)	<ul style="list-style-type: none">• Clarify meaning of carrying capacity in report. Is there a difference between this and sustainability?• Recognize in this section the clear advantages to moving offshore (lowered environmental impacts)• Environmental review requirements should be adaptive as industry grows• Consider ecological sustainability as well• If fish farms located in EEZ, perhaps fishing boats could bring bycatch for farm use• Clarify size and number of farms per area regarding carrying capacity. Cumulative impacts are also important to consider• Consider site-specific, regional, and cumulative impacts of OA projects• Include LOS and Jones Act in this section's list of laws (determine their potential impacts on OA)• Precautionary principle ill-defined and abused in its application (can't be defined, too vague). Don't use it.• Dangerous to use Code of Conduct and BMPs (don't use BMPs). Revise to indicate advantages and disadvantages. Need more clarification. Clarify concept of independent audit• Differentiate public health and environmental impacts monitoring and clarify the standards. Okay to use baselines but a change from a baseline may not necessarily be bad• Gov't should support initial reviews (i.e. costs) while the industry is starting up• Federally funded programmatic EIS for initial sites could do initial assessments• Nutrients in the ocean aren't necessarily bad. Educate regulators and the public	<ul style="list-style-type: none">• Define the precautionary approach/ principle• Participants asked how the environmental assessment (EA) would differ under the 2 options (permit/lease combo vs. separation of permitting and leasing). They noted that an EA conducted for a particular OA project would include permitting issues (i.e. permit/lease combo). One option is for public to pay for a generic or programmatic EA, and then the aquaculture company would provide the detailed assessment• Participants recommended that issues of fishmeal and "trash fish" be addressed at the planning stage of a project• 3 options: concurrent/ collaborative/ consolidated<ul style="list-style-type: none">- need legislation to fold requirements into single process- need non-binding dispute resolution process- recommend collaborative action- tough to change timelines in consolidated approach• AK model - process since 1984 in coastal zone• Does NAFTA have anything relevant here? CEC and WTO.? Team should check• BMPs (Oregon State, NOAA satellite service)• Naylor statement supports bringing in scientists• Changes in system based on monitoring• Carrying capacity examples<ul style="list-style-type: none">- In impact mitigation (WA)- SG study (mussels)- Salmon disease (ME) - consider model in EEZ• Compare to impacts of other industries in EEZ• 2 types of impacts: localized and widespread (i.e. disease)

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Environmental Review	Antibiotics			<ul style="list-style-type: none"> • The use of antibiotics should not be prohibited; will want to utilize existing drugs • The concern (from MMS) is not so much with the environmental impacts of antibiotics, but more with antibiotic body loads • The use of antibiotics should be heavily regulated (and they are by the USDA) • In terms of GMOs, there is some guidance in the FDA on what to put in the cage. The FDA is applying a new drug approval program to aquaculture. • Might think about creating "principles" related to drug and antibiotic use in the industry (i.e. Principle of minimizing the use of drugs) 	<ul style="list-style-type: none"> • Report shouldn't preclude use of antibiotics in cages. Consider situations where they might be permitted 	<ul style="list-style-type: none"> • Adequate coverage already exists for IPM (integrated pesticide management); therapeutants (CHECK)
	Native vs. Nonnative Species/ Invasive vs. Non-invasive			<ul style="list-style-type: none"> • The estimated impacts of an offshore aquaculture project should focus on the impact of escapees on the wild population AND the impact of other species on caged fish • Example of tracking fish, used with salmonids: fin is clipped to distinguish between wild and caged fish at the marketplace and a microchip is inserted. It also shows ownership aspect. • Example of Atlantic Salmon in Pacific (fish that are too genetically similar with wild populations may reproduce with them and cause problems) • Create table in Environmental Review section 	<ul style="list-style-type: none"> • Strong caution expressed by some people about using non-native species in cages, as well as feeding raw feeds. Others felt certain non-native species can safely be cultured offshore because they can't spawn or establish reproducing populations (consider case-by-case and limit regulatory prohibitions) • Lengthy discussion on use of wild fish as feed; conclusion reached that the issue should be fairly discussed in the report, but not considered as part of regulating EEZ aquaculture (others thought it did not belong in aquaculture, but in fisheries management). Focus on the site and the impacts of feeds. • No need to raise exotic species; there are enough good candidate species available regionally. Make definitive statement about use of domesticated and non-native species 	<ul style="list-style-type: none"> • Alternatives: <ul style="list-style-type: none"> - Consider non-native if appropriate control mechanisms available - Opposition also heard regarding use of non-native species • Species-specific impacts and mitigation (i.e. triploidy) not foolproof but risk assessment may show acceptable • Use of wild species in feed (No consensus in Chile, where concerned over mackerel affecting wild fishery) • Escapes - stock selection - science and cage design needed as basis for d-m; mark fish by owner (WA)

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Environmental Review	Water Quality Standards			<ul style="list-style-type: none"> • Must have water quality standards in the EEZ under the CWA • Aquaculture without water quality standards will involve fines/liability (Possible for NPDES to be issued in the EEZ without established water quality standards, but the agency in charge could be challenged and sued) • Important to make any regional differences based on science (not politics) • Standards for Aquatic Animal Production (EPA) effluent guidelines, which could apply to the EEZ, are in public comment/review right now 	<ul style="list-style-type: none"> • Realize we have to expect some impacts from offshore development • Recognize that current EPA/NPDES process is very stringent • Positive impacts of OA on the environment should also be evaluated/monitored (i.e. nutrient enhancement and fish aggregation) 	
	General	<ul style="list-style-type: none"> • Questions about ownership of escapees, ownership of runaway cages • Use Norway, Maine, and Pacific Northwest as models 	<ul style="list-style-type: none"> • Expression of support for the structure and thrust of Operation & Monitoring and Compliance & Enforcement Chapters 	<ul style="list-style-type: none"> • Think about issue of confidentiality vs. transparency (because there are few producers in the market at moment) • If this new industry will be funded with subsidies, should be some public reporting • Mark provision of data part of the permitting requirements • MMS has civil and criminal authority and uniform inspectors; there is public access to data, after certain time period • NMFS has significant enforcement capabilities to take advantage of for policy 	<ul style="list-style-type: none"> • Costs of monitoring should not preclude the project from being cost-competitive and economically feasible. Be reasonable regarding agency and farmer needs. • Regulations should not tell the farmer how to manage a farm, but should provide goals to meet. • Do not have excessive, unreasonable monitoring requirements. Excessive burden should not be placed on pioneer farms • Monitoring protocols should be flexible and decrease in frequency over time • Operation and monitoring should look at cumulative effects and regional impacts • Remember, no baseline information and modeling data are available yet for OA; the initial farms will develop it (work with them) • Baseline data is critical and must be developed and articulated • Predictive modeling is unable to deal with loading and disperse capacities seen in the ocean. Empirical data and cooperation with farmers essential 	<ul style="list-style-type: none"> • Participants emphasized need for the monitoring program to fit the degree of risk and reflect the project type and offshore conditions. Some types of monitoring not necessarily required for all types of operations. • Monitoring of escapes is a type of needed monitoring. The program also needs to require the timely reporting of problems to the agencies • Participants cited need to properly attribute BOD so that industry not blamed for naturally occurring conditions • They also suggested that the team consider tailoring monitoring to <ul style="list-style-type: none"> - what is scientifically needed - using collaborative/cooperative monitoring arrangements • They also emphasized educational aspect of enforcement, and recommended that the report address public education, and training of operators and regulators

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Operation and Monitoring, Compliance and Enforcement	General				<ul style="list-style-type: none"> • Make monitoring costs reasonable and adaptive (protect culturists' rights) • Involve industry in developing monitoring protocols, rules, and regulations • Divert any and all funds to enforcement within the EEZ. Emphasize "protection", not "policing" of operator (they need to know they're safe) 	<ul style="list-style-type: none"> • Environmental - agency issuing permit (NOT USCG) • USACE - annual photo appropriate for some things • Tie enforcement to business and threaten shut-down • What about outside effects on aquaculture? • Who? L-T should fall on industry (after start-up); public for broad-scale monitoring • Flexibility - drop any irrelevant types over time • Discuss necessity for aquaculture development in EEZ/ needs to take place first (will be addressed in legislative process) • Precedent in fisheries for monitoring and enforcement • Baseline pre-permitted by government and recouped costs over time • Confidentiality? Be transparent on outputs (environmental impacts) rather than inputs (business information); leave up to the company • Examine EU example
	Conflict Resolution		<ul style="list-style-type: none"> • Profitability and issue resolution criteria can be used to identify the size of an initial installation. A monitoring program can be used to address uncertainties while growing the operation to full size. Phased development of a site allows monitoring of events and conditions where insufficient information is available 	<ul style="list-style-type: none"> • Broad framework is needed to decide amongst users and to settle conflicts among them 	<ul style="list-style-type: none"> • Involve the commercial sector as much as possible in the implementation, design and enforcement of any new regulations and programs. Create incentives for participation and involvement (i.e., implement rewards programs for monitoring equipment, etc.) 	<ul style="list-style-type: none"> • Dispute resolution process needed in any development process/legislation

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Report #2		<ul style="list-style-type: none"> • Great effort put into the draft document • Chapter 1 <ul style="list-style-type: none"> - Unstated assumption is that the goal of this document is to provide predictability - Should state that the cost of regulations and operations must be less in the US EEZ than in other countries or there will be no investment by large multinationals - Restate the federal goal of increasing aquaculture production - MUST explain somewhere in document: any federal aquaculture legislation must include blanket exemption for aquaculture from FMIPs drawn up by the regional fisheries councils • Chapter 2 <ul style="list-style-type: none"> - Regarding state responsibility: state CZM should include aquaculture. Otherwise, how will applicants deal with state consistency review? - Interagency reviews should be regionalized rather than centralized (not agreement on this point) - NOAA and the Army Corps should be co-lead agencies - May need Interstate Fish Health and Transfer permits to bring live animals through state waters - Agencies should be required to respond in set time period • Chapter 3 <ul style="list-style-type: none"> - Document needs definition section in the appendix (esp. for "sustainability" and "precautionary approach") - Why not go through EISs instead of modeling impacts in advance? - Regulators should bear the cost of modeling (shortcomings) - Alternative approach is to monitor and re-examine (Permit by rule) - Difficult to monitor the EEZ (very high cost) <p>What is the impact of surface gear?</p>	<ul style="list-style-type: none"> • Add statements about the importance of fisheries (i.e. fish products are the #2 imported item in the U.S.) • Be more thorough in documenting the process of reaching recommendations (want thinking process, "option development") • Include diagram for each chapter illustrating the recommended process for each chapter and at end of report, incorporate all diagrams into super diagram showing entire process (temporal) • Possibly move Siting section closer to Administration section • Think about operationalizing the recommendations • Think of necessary changes in legislation (timeline) 	<ul style="list-style-type: none"> • The Pacific Islands have a unique status regarding OA that must be understood and included in the report. • Couching the report as economic (aquaculture) development of the EEZ would be better than simply providing a regulatory/governance framework. Would change the whole tone of the report, and the planning /implementation functions proposed. If economic development was the goal, siting studies and the permitting/leasing structure would have more support. • Finish growers need to be well represented in Team discussions, as they will be driving the offshore industry's progress. • Discuss wild species management and regulatory issues (federal and state) and their impact on OA 	<ul style="list-style-type: none"> • Consider GMOs • Address benefits of aquaculture projects and OA in general • Include references to international obligations of the United States and how they will be addressed • Suggestions for the framework included: <ul style="list-style-type: none"> - Science-based decision-making - Outcome-based approach (overall) - Enabling language - Criteria for development - Tolerance of some risk • Look at examples for useful models and insights (for regulatory approach): <ul style="list-style-type: none"> - The grazing rights program, which requires USDA and DOI permits - Performance requirements on existing oil and gas leases, which may be applicable to aquaculture leases - State CMPs, which include water quality standards - The European Union approach (planning, administration, and development) - OIE and codex alimentarius, which employ risk analysis in choosing projects - NPDES self-enforcement model • It would be a mistake to use an extraction model for aquaculture • Ask WA State tribes for comments on report)

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Report #2		<p>• Chapter 4</p> <ul style="list-style-type: none"> - Question regarding eligibility standards (should only be considered when beginning operations; strong objection to any limits on applicants' nationality) - Need for priorities between competing applicants - Objectives should be to verify and validate math models - Charge should not be made to seed stocks - Possible designation of DOI as lead mapping agency - Maine uses "permit by rule" - 1 yr/time - Length of short-term experimental lease should be linked to species being grown <p>• Chapter 5</p> <ul style="list-style-type: none"> - Replace "medicine" with "therapeutant" - Who pays for monitoring costs? - Page 60, Jurisdictional Issues - NOAA identified for specific species only in MSA - Alternative is to give a provisional lease (10- yr) - Time frames for permits should be extensively increased (long-term 50 yr). At any time applicant fails to meet permit/lease conditions, the permits could be withdrawn - Lease renewal at term's end should be automatic (virtually guaranteed) - p. 62, 2nd paragraph. User equity to make industry more comfortable. No preemptive assumption of priority. Goal of having regulations be predictable <p>• Chapter 6</p> <ul style="list-style-type: none"> - Page 74. Codes of Practice may be more effective than regulation. Industry generated, regulator approved, 3rd party audited, w/ transparency - codes very effective. Well accepted by NGOs and lead to better performance (consider Maine Biosecurity Report) <p>• Chapter 7</p> <ul style="list-style-type: none"> - Consider moving to front of report - or give executive summary up front 			
Source: Prepared by Meredith Blaydes, Center for the Study of Marine Policy, University of Delaware, 2003.					



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