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S. HRG. 109–1109

OFFSHORE AQUACULTURE

HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL OCEAN POLICY STUDY

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

APRIL 6, 2006

Printed for the use of the Committee on Commerce, Science, and Transportation

U.S. GOVERNMENT PRINTING OFFICE

64–138 PDF WASHINGTON : 2011

For sale by the Superintendent of Documents, U.S. Government Printing Office
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OFFSHORE AQUACULTURE

THURSDAY, APRIL 6, 2006

U.S. SENATE,
SUBCOMMITTEE ON NATIONAL OCEAN POLICY STUDY,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10:05 a.m. in room SD–562 Dirksen Senate Office Building, Hon. John E. Sununu, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. JOHN E. SUNUNU, U.S. SENATOR FROM NEW HAMPSHIRE

Senator SUNUNU. Good morning. Welcome to this hearing of the National Ocean Policy Study on offshore aquaculture. I want to welcome our witnesses and appreciate them taking the time to be here today. Some of you have traveled from very far away, but we value your expertise, and we appreciate your patience. American consumers are enjoying more seafood every year. But to a large degree, the increase in consumption is not coming from the wild. Global fishing harvests nationally have been level for the past decade, and we are seeing increased pressure on wild fish populations in all of our fisheries. We are getting a great deal of this increase from overseas, and much of the increase in imports comes from fish farms far from the reach of U.S. environmental regulations. We have imported over a billion pounds of shrimp for each of the last 3 years. Atlantic salmon imports have more than doubled since 2000, and tilapia imports have tripled in the same time. Today's hearing will examine an alternative method for meeting this growing demand; growing fish in underwater cages in the open ocean, aquaculture. The United States lags behind a dozen nations, as far away as China, Norway, and Australia, and as close as Mexico and Canada, in developing offshore aquaculture. We are joined today by some of our country's pioneers in this emerging field. We'll learn how far aquaculture technology has come in recent years and the complex questions that need to be answered before we can implement a strong national policy for offshore aquaculture in this country. Today, I'd ask that the witnesses submit any written testimony that they have and that all of the material they submit be part of the record, but we will keep the record open for 2 weeks for any additional questions that Members of the Commerce Committee might have for today's witnesses. We have also received testimony from a number of organizations, including the National Fisheries Institute, Hubbs-SeaWorld Research Institute, The Marine Fish-

eries Advisory Committee, and Environment Matters, and I ask consent that all of their testimony be made part of the record.

We also have opening statements from Senators that have been submitted, and all Senators opening statements will be included in full in the record.

We have six witnesses with us today, each providing a different perspective of background experience and expertise, which the Committee values. It has been a long time since Congress has really taken up the issue of aquaculture. I believe the first national aquaculture legislation was passed back in 1980. But even though that legislation called for a national framework, we have still yet to develop a comprehensive national policy. So, my hope is that this hearing will be part of the process of developing legislation that makes sense, that exercises the right amount of caution and prudence in dealing with environmental matters, but at the same time, takes advantage of the technologies and the approaches that we know exist and that can provide safe quality seafood for consumers in America and around the world. I will ask that we provide testimony. We'll go from left to right. Let me briefly introduce each of our panelists, and then we'll begin with Dr. Bill Hogarth. Dr. Hogarth is Assistant Administrator of the National Marine Fisheries Service, responsible for overseeing the management and conservation of marine fisheries and the protection of marine mammals, sea turtles, and coastal fisheries within the United State's Exclusive Economic Zone. We are also joined by Dr. Richard Langan from UNH. That's the University of New Hampshire for those of you that aren't running for President this year. They have partnered with NOAA for 10 years, since the late 1990s, on demonstration products for showing different techniques for raising species in the often chilly, and sometimes rough waters off the coast of New Hampshire. Randy Cates is President of Cates International. He founded Cates International 5 years ago and has harvested over a million pounds of native Hawaiian moi—I believe—is that how we pronounce that—in waters just south of Oahu. Mark Vinsel is Executive Director of the United Fishermen of Alaska. Dr. Rebecca Goldburg is a Senior Scientist with Environmental Defense. She helped to write the Pew Oceans Commission's 2001 report on marine aquaculture. As everyone knows, the Pew Oceans Commission's work has been part of the body of work that our Subcommittee has drawn on for some guidance in areas where we need to conduct hearings and craft legislation to do a better job in formulating a comprehensive approach—not just to aquaculture, but to fisheries and our oceans management, generally speaking. And Sebastian Belle serves as Executive Director of the Maine Aquaculture Association. He began his career as a commercial fisherman and has served as a technical consultant and project manager on over 20 major commercial aquaculture ventures in 14 different countries. Welcome to all of you, and let us begin today with Dr. Hogarth.

STATEMENT OF DR. WILLIAM T. HOGARTH, ASSISTANT ADMINISTRATOR FOR FISHERIES, NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (DOC)

Dr. HOGARTH. Chairman Sununu, good morning, and thank you for inviting me here today to testify on behalf of the Administration. I am Bill Hogarth, the Assistant Administrator for Fisheries, National Oceanic and Atmospheric Administration within the Department of Commerce. My testimony today will address the opportunities and challenges posed by the offshore aquaculture and present some compelling reasons for prompt Congressional action on S. 1195, the National Offshore Aquaculture Act of 2005. To begin, I would like to note that the Secretary of Commerce, Carlos Gutierrez, was very interested in testifying today and regrets that he could not be here this morning. However, he expresses his full support for the bill and asked that I share his statement with the Subcommittee. His statement is: I am convinced that the United States must explore the potential of offshore aquaculture to help meet the growing demand for seafood in this country and to create jobs and economic opportunity for coastal communities. To support that, we are making the National Offshore Aquaculture Act of 2005 a priority of the Department and this country. We need to create this opportunity now. As the Secretary states, we believe there is a compelling case for the development of the domestic marine aquaculture industry in the United States to meet the growing demand for seafood. Seafood is a very healthy food, and nutritionists are encouraging Americans to increase their consumption of seafood. We already import over 70 percent of our seafood, and half of these imports are products of aquaculture. With an annual seafood trade deficit on the order of $8 billion dollars, the United States clearly could benefit from increasing its domestic aquaculture production. Aquaculture operations in Federal waters can increase domestic seafood supply, provide jobs for economically-depressed coastal communities, reduce our Nation's growing dependence on seafood imports, and increase regional food supply and security. However, at the same time, these operations must be carefully sited, regulated, and monitored. S. 1195 maps out a strong framework for safe, sustainable marine aquaculture operations in the U.S. One of the driving forces behind this bill is the need for regulatory certainty, which is vital for potential investors in offshore operations. Business needs regulatory certainty in order to make sound investment and financing decisions. Those concerned about the impacts of offshore aquaculture need to recognize that the industry will be held to strict environmental standards. Enactment of S. 1195 would provide the Department of Commerce authority to directly regulate aquaculture in Federal waters and to establish a coordinated process among the Federal agencies that have responsibilities over certain aspects of offshore aquaculture operations under other statutes. We envision a one-stop permitting system coordinated by NOAA and integrated with NOAA's environmental stewardship responsibilities. Action on S. 1195 will allow us to begin a public rulemaking process to produce a comprehensive environmentally-sound permitting and regulatory program for aquaculture in Federal waters, as we indicated we would do as part

of the President's U.S. Ocean Action Plan. Since last June, we have heard from many stakeholders who are eager to discuss the pros and cons of the bill. I have included an attachment to my written testimony that will clarify specific questions that have been posed by the stakeholders during the discussions we have had. We are also aware of the additional statements which have been submitted by other groups for this hearing. I would like to use the rest of my time to focus on what this bill means for our coastal communities and especially for the fishing industry. First, aquaculture is an important opportunity for coastal communities. More and more communities are recognizing that aquaculture presents a sustainable alternative for areas hard hit by job loss, natural disasters, or other challenges. As interest grows, these communities are beginning to take the initiative to integrate aquaculture into their economy. For example, in New Hampshire, the Isle of Shoals blue mussels, and in Brownsville, Texas, red drum and shrimp. And now, they're looking at scallops and offshore aquaculture. Second, offshore aquaculture properly managed, will complement our Nation's commercial fisheries—I said complement our Nation's commercial fisheries. Some critics of S. 1195 expressed concern that offshore aquaculture will hurt wild harvest in the United States. Properly managed aquaculture, we do not believe will affect annual harvests from our Nation's wild harvest. We recognize that aquaculture, whether imported or domestic, does in fact compete with wild fisheries products in the marketplace. That competition will not go away in the absence of domestic aquaculture. We live in a global market. The challenge is to integrate aquaculture into domestic seafood production so that our fishermen, processors, and marketing companies can benefit directly from aquaculture. Recreational and commercial fishing will also benefit from hatcheries and stock enhancement techniques developed for offshore aquaculture. Currently, U.S. hatcheries are used to grow finfish and shellfish for stock enhancement to support recreational and commercial fisheries—red drum enhancement in the Gulf based at the Gulf Coast Research Lab, and the white seabass enhancement program in California. In summary, the United States needs a strong commercial fishing industry and a robust aquaculture industry. Demand for seafood products in this country is growing, and we do not have the ability to meet domestic demand through wild-caught fishing alone. We estimate that one million tons of domestic aquaculture production from all forms of aquaculture will create 25,000 direct and 50,000 indirect jobs in the United States. This bill is the first step in a process to establish a regulatory structure. We want to work with the Committee to develop language to address the opt-out and environmental standards and amendments. Mr. Chairman and Members of this Subcommittee, the Department is looking forward to working with you, the public, the fishing and aquaculture industries, and the environmental community to craft a regulatory framework for offshore aquaculture. The United States must take the initiative to become self-sufficient in the production of healthy seafood, provide jobs, and reduce the seafood trade deficit. We must develop aquaculture as a tool to complement commercial fishing because we will need both to produce from wild and

aquaculture to meet our growing demand for healthy seafood. Thank you.

[The prepared statement of Dr. Hogarth follows:]

PREPARED STATEMENT OF DR. WILLIAM T. HOGARTH, ASSISTANT ADMINISTRATOR FOR FISHERIES, NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (DOC)

Chairman Sununu, and members of the Subcommittee, good morning and thank you for inviting me here today to testify on behalf of the Administration. I would also like to thank Senator Stevens and Senator Inouye for introducing S. 1195, the National Offshore Aquaculture Act of 2005. I am William Hogarth, Assistant Administrator of the National Marine Fisheries Service, National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce.

Secretary of Commerce Carlos Gutierrez was interested in testifying today and regrets that he could not be here this morning. He expresses his full support for the bill and asked that I share this statement with the Subcommittee.

> "I am convinced that the United States must explore the potential of offshore aquaculture to help meet the growing demand for seafood in this country and to create jobs and economic opportunity for coastal communities. To support that, we are making the National Offshore Aquaculture Act of 2005 a priority for this department and this country. We need to create this opportunity now."

We believe that there is a compelling case for the development of the domestic marine aquaculture industry in the United States to meet the growing demand for seafood. Nutritionists are encouraging Americans to increase our consumption of seafood. We already import over 70 percent of our seafood and half of those imports are products of aquaculture. The United States could benefit from increasing its domestic aquaculture production, which includes the propagation and rearing of aquatic organisms in controlled or selected environments for any commercial, recreational, or public purpose.

We want to work with you and our stakeholders to create an opportunity for aquaculture in Federal waters so that we can ensure that the industry develops in a predictable, environmentally-compatible, and sustainable manner, in cooperation with our wild harvest. We also want to ensure that the protection of the marine environment, the rights of other users of marine resources, and human health and safety are a top priority. At NOAA, we have already taken steps to prepare for our role as the regulator for offshore aquaculture.

My testimony today will address the opportunities and challenges posed by offshore aquaculture. I am also including an attachment that will clarify specific questions commonly posed by stakeholders with regard to S. 1195, NOAA's Aquaculture Program, and broader issues related to aquaculture.

The *National Offshore Aquaculture Act* Is a Starting Point

Offshore aquaculture requires careful consideration on many levels, and S. 1195 maps out a strong framework for safe, sustainable marine aquaculture operations in Federal waters. Regulatory uncertainty is widely acknowledged as the major barrier to the development of offshore aquaculture in the United States. The bill will provide regulatory certainty, which is important to the offshore aquaculture industry as well as to those who are concerned about the potential impacts of offshore aquaculture. Business needs regulatory certainty in order to make sound investment decisions and obtain financing. Those concerned about the impacts of offshore aquaculture need to know that the industry will be held to strict environmental standards.

Enactment of S. 1195 provides the Department of Commerce the authority to directly regulate aquaculture in Federal waters, and to establish a coordinated process among the Federal agencies. We envision a one-stop regulatory shop, coordinated by NOAA, and integrated into NOAA's environmental stewardship responsibilities. Action on the Administration's bill will allow us to begin a public rulemaking process to produce a comprehensive, environmentally-sound permitting and regulatory program for aquaculture in Federal waters, as we indicated we would do as part of the *U.S. Ocean Action Plan.*

At the same time, NOAA views S. 1195 as a starting point. Since last June, there have been a number of suggestions from a variety of stakeholders to improve the bill. One example is environmental standards. NOAA acknowledges the concerns expressed by stakeholders and would like to work with Congress to take a closer look at their suggestions.

Aquaculture Is an Important Opportunity for Coastal Communities

More and more communities are recognizing that aquaculture presents a sustainable alternative for areas hit hard by job loss, natural disasters, or other challenges. As interest grows, these communities are beginning to take the initiative to integrate aquaculture into their economy. For instance, in Brownsville, Texas, a diverse set of interests, including local fishermen, seafood processors, distributors, entrepreneurs, university representatives, and others met recently to discuss opportunities for aquaculture operations in their city. Like other maritime communities, Brownsville has boats, fishermen, processing plants, hatcheries, distribution centers, and a whole seafood infrastructure that could be put to work year round with a steady, reliable source of product from aquaculture.

Aquaculture, like agriculture, requires inputs of goods and services from many sources, while its outputs are processed into value-added offerings. Beneficiaries include owners and employees of aquaculture businesses, equipment suppliers, boat owners and operators, feed ingredient suppliers such as soybean farmers and fishermen who supply fishmeal, feed manufacturers, seafood processors, and transportation and distribution companies. Other opportunities include sales, marketing, and accounting services. In turn, these activities benefit the coastal communities in which these businesses operate, as well as the increasing portion of the general public who eat seafood and benefit from its health attributes.

Overall, NOAA estimates that one million tons of domestic aquaculture production—from all forms of aquaculture, including freshwater and marine—will create 25,000 direct and 50,000 indirect jobs in the United States. Aquaculture in Federal waters could make a significant contribution to this level of job creation.

Offshore Aquaculture and Commercial Fisheries

While we are certain that there could be direct economic benefits from our bill, we must consider its potential impacts, including the impact on our Nation's commercial fisheries. Some have expressed concern that offshore aquaculture will hurt wild harvest in the United States. If aquaculture is managed correctly, we do not believe wild harvest will be impacted.

Aquaculture, whether imported or domestic, competes with wild caught fisheries. We acknowledge that concern, but that competition will not go away in the absence of domestic aquaculture. We live in a global market. Demand for seafood products in this country is growing and we simply do not have the ability to meet that demand through wild-caught fishing activities alone. Significant competition is already coming from imports and from other forms of protein such as beef and chicken. Over 70 percent of the seafood Americans' consume annually is imported. Half of those imports come from foreign aquaculture operations. The challenge is to integrate aquaculture into domestic seafood production so that our boat owners, fishermen, processors, and marketing companies can benefit directly from aquaculture.

In some cases, U.S. fishermen have already integrated with or linked to aquaculture. Examples include:

- Fishermen in New England who are interested in adding aquaculture as part of their business and researchers at the University of New Hampshire are working in tandem to design equipment, site operations, share knowledge, and service and operate cod and mussel farms in open ocean locations.
- Fishermen in Florida and New England, displaced by closures of wild fisheries or declining catches, have turned to shellfish aquaculture.
- States along the Gulf of Mexico are looking to aquaculture to help rebuild seafood infrastructure and retain seafood jobs. Fishing communities damaged by the hurricanes are seeking to rebuild docks, processing, and distribution facilities. Aquaculture could provide additional fish and shellfish to local processing plants, and fishermen may be able to use existing vessels to support aquaculture operations.

Recreational and commercial fishing will also benefit from hatcheries and stock enhancement techniques developed for offshore aquaculture. Currently, U.S. hatcheries are used to grow finfish and shellfish for stock enhancement for recreational and commercial fishing with great success. For example, recreational fishermen in Southern California work closely with the Hubbs-SeaWorld Research Institute on a white seabass restocking program. It is an excellent program and one that helped rebuild and sustain the valuable recreational fishery for seabass in California.

The United States needs a strong commercial fishing industry *and* a robust aquaculture industry in order to meet projected seafood demand and supply the Nation's stock enhancement needs. While we look for aquaculture to help meet demand, NOAA will continue to assist wild capture fisheries with management programs,

stock enhancement, and marketing to channel wild capture products to high-valued premium markets outlets—such as the shrimp and salmon marketing programs. But we also need to supply that vast middle market that demands a year-round supply of affordable, healthy, safe seafood—and we can do that through domestic aquaculture.

Aquaculture Research and Technology Development Provide Economic Benefits

As the world moves toward aquaculture in offshore waters, another key factor is technological innovation—an area where the United States is a world leader. As a concept, offshore aquaculture has been around for years. However, the technological advances and other research applications that now make offshore aquaculture possible have only come online within the last 10 years. For example, equipment innovations for the offshore include submersible cages and remote-controlled feeding apparatuses—all designed to withstand the challenges of the ocean environment.

To date, with leadership and foresight provided by NOAA through the *National Marine Aquaculture Initiative,* the United States has invested just over $10 million in offshore aquaculture research, and the technology is now being used in commercial applications. Examples include:

- Two finfish operations in Hawaii and one in Puerto Rico using submersible cages designed and produced in the United States have become commercially viable. The owner/operators of these facilities include a local commercial fisherman, a family company in the seafood business, and U.S. investors.
- Two commercial mussel farms owned and operated by fishermen have started production off New Hampshire.
- Additional projects are in design in the Gulf of Mexico, the Virgin Islands, and California. All involve some combination of U.S. investors, coastal fishermen, university scientists, and local processing, hatchery, feed, and equipment supply companies.

U.S. research and technology development will continue to provide key contributions to aquaculture development made possible by S. 1195.

S. 1195 Will Provide for the Sustainable Development of Offshore Aquaculture

The *National Offshore Aquaculture Act* will enable offshore aquaculture, provide safeguards for the marine environment, and balance multiple uses of the oceans and coasts by providing for the establishment of siting, operating, and environmental criteria; the monitoring of environmental impacts; and the enforcement of regulations and permit conditions.

The bill will:

- Authorize the Secretary of Commerce to issue offshore aquaculture permits and to establish environmental requirements where existing requirements under current law are inadequate;
- Stipulate that aquaculture products will not be subject to fishing regulations that restrict size, season, and harvest methods;
- Require the Secretary of Commerce to work with other Federal agencies to develop and implement a coordinated permitting process for aquaculture in Federal waters. This includes the authority to set additional environmental requirements to ensure that such development proceeds in an environmentally-responsible manner that is consistent with stated policy to protect wild stocks and the quality of marine ecosystems and is compatible with other uses;
- Authorize the establishment of a research and development program in support of offshore aquaculture; and
- Provide for enforcement of the Act.

The bill will not supersede existing laws such as those concerning navigation, offshore structures, management of fisheries, environmental quality, protected resources, and coastal zone management.

If the legislation is enacted, NOAA estimates that development of detailed implementing regulations should take two to 3 years, including the development and publication of draft rules, a review period, and publication of final rules. Environmental standards and other permit requirements will be designed with public input, and the process will allow for public review and comment through *Federal Register* notices as well as meetings with states, fishery management councils, and other forums. We already have good models of regulations from coastal states and other industrialized countries as well as industry best management practices.

Other Federal activities, led by NOAA and supported by other Federal agencies, that will support implementation of the bill—and ensure rational and sustainable development of aquaculture—will include:

- Mapping and data gathering to identify areas best suited for offshore aquaculture;
- Additional economic and social analysis of regulatory options, species, and production methods;
- Continued research on environmental issues and best management practices; and
- Pilot and demonstration projects with public and private sector partners and coastal communities.

This bill is a first step in what will be a careful and inclusive process to establish a regulatory structure for offshore aquaculture. This will be done step-by-step. NOAA believes that carefully sited, regulated, and monitored finfish and shellfish operations in U.S. Federal waters can be an effective way to reduce our Nation's growing dependence on seafood imports, provide jobs for economically-depressed coastal communities, and increase regional food supply and security. We also believe that this is an opportunity for the United States to lead by example and encourage aquaculture operators in other countries to adopt best management practices developed here.

NOAA Prepares for Offshore Aquaculture in the United States

NOAA has been working on this issue for the last 10 years, preparing for it on many fronts. Specific steps the agency is currently taking to prepare include:

- Designing environmental risk management guidelines for aquaculture, as highlighted in a recently published NOAA technical memo;
- Developing an economic analysis of offshore aquaculture for delivery later this year;
- Outlining environmental impact statement (EIS) and regulatory design steps to be taken if legislation is passed;
- Conducting ongoing consultations with communities and businesses; and
- Examining aquaculture's role in ecosystem management with an international group of experts.

Conclusion

Mr. Chairman and members of this Subcommittee, the Department is looking forward to working with you, the public, the fishing and aquaculture industries, and the environmental community to craft a regulatory framework for offshore aquaculture. A strong, comprehensive framework will offer the regulatory certainty industry needs while safeguarding the marine environment, and creating economic opportunities for those Americans who depend on an abundance of marine resources for their livelihood. The United States must take the initiative to become more self sufficient in the production of healthy seafood, provide jobs for coastal communities, and reduce the seafood trade deficit. We must develop aquaculture as a tool to complement commercial fishing because we will need both to produce seafood to meet the growing demand.

I appreciate the opportunity to present the *National Offshore Aquaculture Act of 2005* to you today, and I would be happy to answer any questions.

ATTACHMENT

The information in this attachment is intended to clarify specific issues or questions posed by stakeholders with regard to S. 1195, as well as broader issues related to aquaculture.

Definition of Aquaculture—NOAA's definition of aquaculture is, "The propagation and rearing of aquatic organisms in controlled or selected environments for any commercial, recreational or public purpose." This definition was established in the *1998 NOAA Aquaculture Policy*.

Role of Coastal States—S. 1195 requires coordination with states during the regulatory design process and establishment of environmental and other requirements that would follow enactment of a bill, and also as part of the review of each individual permit application. S. 1195 specifically includes a provision on the need to consult with state agencies as part of the coordinated and streamlined permit process for offshore aquaculture, so states will have a say in decisions on offshore aquaculture permits as well. S. 1195 does not supersede any other laws, such as the

Coastal Zone Management Act, that include a role for states with respect to activities in Federal offshore waters. In addition, the offshore aquaculture facilities will require support facilities on land and the landing of seafood product on land—both of which will be subject to state and local approvals.

Role of Fishery Management Councils—NOAA has an ongoing working relationship with the Regional Fishery Management Councils, established under the *Magnuson-Stevens Fishery Conservation and Management Act.* S. 1195 requires NOAA to consult with these Councils in developing and implementing the regulatory regime for offshore aquaculture development. Since the Administration's bill was introduced, NOAA has briefed the councils on the legislation, and begun to engage them in our planning for how the bill would be implemented. NOAA would consult with the Councils in the regulatory design process, in the establishment of environmental and other requirements—especially as they relate to interactions with wild stocks managed by the Councils—and in the review of individual permit applications.

Environmental Standards—The question of environmental standards for offshore aquaculture is an important one and the establishment of rigorous environmental standards for offshore aquaculture is central to the *National Offshore Aquaculture Act.* S. 1195 provides the necessary authority to require, through regulations or permit conditions, appropriate measures to avoid, minimize, or mitigate unacceptable impacts. The bill also provides authority to take emergency actions to address unanticipated impacts in a timely manner. S. 1195 does not override or preempt existing laws to protect the marine environment, wild stocks, endangered species, marine mammals, and habitat.

Space Requirements and Siting—We believe that space requirements and siting issues for offshore aquaculture operations can be addressed by careful mapping of existing uses of the open ocean and in consultation with coastal communities and users of ocean space. The U.S. Exclusive Economic Zone (EEZ) is the largest in the world. It spans over 13,000 miles of and contains 3.4 million square nautical miles of ocean. It is larger than the combined land area of all 50 states. Based on our pilot and demonstration projects, the total spatial demands for the different components of an offshore operation are relatively small compared to the EEZ. According to estimates from experts at NOAA, it would require less than 1 percent of the area currently set aside for the National Marine Sanctuaries to produce about one million tons of seafood in the United States. To get a sense of spatial requirements, it is estimated that 100 farms producing 1,000 tons of seafood each would, in total, occupy an area about the size of the Pentagon complex [1 square mile]. Another example of the projected spatial impact of offshore aquaculture is the area needed to produce 80,000 metric tons of mussels. According to NOAA experts, that level of production would require an area less than 10 square miles, or less than the size of the Kennedy Space Center at Cape Canaveral.

Fish Meal—In the wild, fish such as salmon will consume roughly 10 pounds of fish to gain one pound of body weight. Cultured marine finfish also consume wild fish—albeit as an ingredient in formulated feed made from fishmeal and oil, and vegetable-based fats, proteins, and carbohydrates. As a result, cultured fish consume only about three pounds of processed, wild fish for every pound they gain. Because feed is a major component of an aquaculture operation's cost of production, there are strong economic incentives for the aquaculture industry to substitute less costly ingredients for fish meal and fish oil in feed formulas, and to become more efficient in converting feed into product. Research into plant-based alternatives to fish meal, such as soybeans, is expanding. However, research on plant-based alternatives in fish meal has found that maintaining some fish oil or suitable alternatives in fish feed is important in order to maintain the health benefits of marine fish, including the Omega-3 fatty acids. In addition to industry, NOAA and other Federal agencies are working on research to develop protein substitutes to reduce reliance on fish meal and oils, such as marine algae. These agencies will continue to work with grain and feed companies and feed researchers to find suitable alternatives.

The source for most of the world's fish meal in feed is the anchovy fishery off the coast of South America. U.S. fishermen also land sardines and menhaden used in fish meal. The annual capture of these fish has remained stable since the 1960s, despite the steady rise in aquaculture and the continued consumption of fish meal in the pork, poultry and pet food industries. However, wild caught fishmeal sources are not likely to continue to be able to satisfy the demand for fish meal from aquaculture and terrestrial agriculture.

Escapes—The issue of escapes is being addressed with technological innovation, best management practices, and careful species selection. For example, the use of submersible cages for offshore aquaculture reduces the vulnerability to storm damage that can lead to escapes. In addition, the knowledge NOAA and other agencies

have gained from stock enhancement programs for commercial and recreational fishing—deliberate releases of finfish, oysters, and crabs—allows managers to design safeguards for conserving wild stock.

Aquatic Animal Health—Disease transmission is becoming less of a concern for aquaculture, since the marine aquaculture industry has replaced antibiotics with vaccinations administered before fish are stocked into cages. NOAA, working with the U.S. Department of Agriculture and other Federal agencies, is also at the forefront in developing a *National Aquatic Animal Health Plan* which will provide for safe national and international commerce of aquatic animals and the protection of cultured and wild aquatic animals from foreign pests and diseases.

Senator SUNUNU. Thank you very much, Dr. Hogarth. We are joined by my Co-Chairman on this Subcommittee, Senator Boxer, and Senator Stevens and Senator Inouye as well, and I would like to turn to them now before proceeding with Dr. Langan for their opening statements. So, we'll begin with Senator Stevens.

Senator STEVENS. Well, I'm just happy to be here with Mark Vinsel.

Senator SUNUNU. Thank you. Senator Boxer?

STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM CALIFORNIA

Senator BOXER. Thank you so much. Mr. Chairman, it's great to join you again. We did some good work last year with the help of our Co-Chairs. We legislated on ballast water invasive species prevention and coral reef protection, and I'm hoping we can make some headway on this issue. I'd ask unanimous consent that my full statement be placed in the record, if I might——

Senator SUNUNU. Without objection.

Senator BOXER.—but I would like to share with the Subcommittee and the witnesses some of my thoughts here because perhaps they can answer some of my questions. Last June, I introduced the National Oceans Protection Act, which is a comprehensive bill based on the recommendations of the United States Commission on Ocean Policy. And today, we address one of those very important matters covered in the bill—offshore aquaculture. And I think it's important because I think it raises a number of concerns as well as some wonderful possibilities. Let me begin by saying I am not opposed to offshore aquaculture, but it has to be clear that when you raise these fish in crowded cages on the open seas, there are a number of health, safety, economic, and regulatory concerns that I think are raised. And I think we need to make sure that strong safeguards are in place before we proceed with any offshore aquaculture permitting. In other words, let's try to do this wisely so that we are not facing issues later that come back to haunt us or trouble us. Let me quickly state those concerns. Offshore fish farms can create clouds of ammonia, phosphorus, and other wastes, and they could contribute to problems such as poor water quality that not only harm the farmed fish, but also the marine ecosystem. Escaped farmed fish can adversely harm wild fish. They can threaten the genetic stock of wild fish and introduce diseases and parasites. Escaped farmed fish will also compete with wild fish for food and habitat. The biggest concerns I have about offshore aquaculture deal with potential threats to human health from large-scale farmed fish operations. In 2004, a study published in *Science* found that farm-raised salmon contain higher levels of chemical

pollutants than wild fish, including PCBs, which are known carcinogens. And I just wanted to say to my colleagues, when you go to a restaurant in my state, in California, the patrons just always ask are you serving wild fish, or is it farmed fish. And I will tell you, many people will not eat the farmed fish because of these concerns. Increased PCBs are due to the fishmeal that's often used to sustain mass-scale aquaculture. In May 2005, a study found that chemical levels in farm-raised salmon were so high that in order to lower the cancer risk to the middle of the EPA's acceptable range, people should effectively stop eating them. Another major health concern is the excessive use of antibiotics to prevent and treat diseases in farmed fish. These are very legitimate concerns, and this is why we must move in a deliberate, careful way before any regulatory program is authorized. I am concerned that if we go into a fast-track mode here and we allow this to go forward without the standards in place, that it—again, it could be a bad situation. And rather—I would rather see us establish uniform and strong standards nationwide as called for by the U.S. Ocean Commission. And so, I am concerned that the way the Administration is moving on this and some of our colleagues, the bill would allow for permitting each potential fish farm on an ad hoc basis before we have, you know, really taken a look at this in a global fashion. My Oceans bill requires a full regulatory process be in place to address the concerns I have discussed before any aquaculture is permitted. In closing, I think there are still many open questions. I hope that the witnesses today will answer some of my concerns. I am really looking forward to that so we can learn more about how we can address some of these problems and make sure that they don't occur. So, I do look forward to the testimony, and I thank you, Mr. Chairman, for your leadership on this.

[The prepared statement of Senator Boxer follows:]

PREPARED STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM CALIFORNIA

Mr. Chairman, it is great to join you again—Last year, this subcommittee held hearings on two very important oceans issues: ballast water invasive species prevention and coral reef protection.

This year, the Subcommittee has a tremendous opportunity to hold hearings on very important matters of ocean policy.

Last June, I introduced the National Oceans Protection Act—a comprehensive bill based on the recommendations of the U.S. Commission on Ocean Policy.

Today, we address one of those very important matters covered by my bill—offshore aquaculture—and it is important because I believe there are a number of concerns that we need to carefully consider.

Let me begin by saying that I am not opposed to offshore aquaculture—however, it should be clear to everyone here that raising carnivorous fish in crowded cages on the open seas raises a number of health, safety, economic, and regulatory concerns—because of these concerns, I think we need to make sure that strong safeguards are in place *before* we proceed with any offshore aquaculture permitting.

I would like to take a few minutes and discuss some of those concerns now.

Offshore fish farms can create clouds of ammonia, phosphorus and other wastes—wastes that can contribute to problems such as algal blooms and poor water quality, harming not only the farmed fish, but also the marine ecosystem.

Escaped farmed fish can adversely harm wild fish too—they can threaten the genetic stock of wild fish and introduce diseases and parasites. Escaped farmed fish will also compete with wild fish for food and habitat.

The biggest concerns I have about offshore aquaculture deal with potential threats to human health from large-scale farmed fish operations.

In 2004, a study published in *Science* found that farm-raised salmon contain higher levels of chemical pollutants than wild fish, including PCBs, which are known

carcinogens—the increased PCBs are due to the fish meal that is often used to sustain mass-scale aquaculture.

Another major health concern is the excessive use of antibiotics to prevent and treat diseases in farmed fish. Such use of antibiotics could strengthen bacterial resistance to antibiotics in fish, and, potentially, increase drug resistance in humans.

These are very legitimate concerns and this is why we must move in a deliberate, careful way before any regulatory program is authorized.

Unfortunately, the Administration's proposal jumps full sail into fast-track permitting for large commercial fish farms, with few criteria for protecting the environment, consumers, or fishing businesses and communities.

Rather than establishing uniform—and strong—standards nationwide, as called for by the U.S. Ocean Commission, the bill instead allows for permitting each potential fish farm on an ad hoc basis.

This is not the kind of policy we should be promoting, especially when there are so many potential environmental and health concerns associated with large-scale aquaculture.

My Oceans bill requires that a full regulatory process be in place to address the concerns I have discussed, *before* any aquaculture is permitted in offshore waters.

It also sets up a governance structure for offshore uses, requiring that environmental concerns be addressed before any potential offshore use is officially sited, and it prohibits siting in special protected areas, such as National Marine Sanctuaries.

Clearly, there are still many open questions and it is my hope that over the course of this hearing and the coming months, we can learn more about how we can address some of the problems that aquaculture has had in the past.

I look forward to hearing the testimony of the witnesses and to working with my Chairman and my colleagues on this important issue.

Senator SUNUNU. Thank you, Senator Boxer. Senator Inouye.

STATEMENT OF HON. DANIEL K. INOUYE, U.S. SENATOR FROM HAWAII

Senator INOUYE. Mr. Chairman, I thank you for scheduling this hearing. Obviously, the State of Hawaii is very much concerned about aquaculture in its surrounding waters. We are constantly alert to invasive species and alien species and the impact it would have upon the wild stocks, but I am also aware that one-fourth of all the fish consumed in this world are the results of aquaculture. It is big business. It is necessary to feed our population. And so, I will be listening to the remarks and testimony very carefully, Mr. Chairman. Thank you very much.

Senator SUNUNU. Thank you, Senator. Dr. Langan, welcome.

STATEMENT OF DR. RICHARD LANGAN, DIRECTOR, UNIVERSITY OF NEW HAMPSHIRE OPEN OCEAN AQUACULTURE PROJECT

Dr. LANGAN. Mr. Chairman, members of the Subcommittee, thank you very much for giving me the opportunity to share my thoughts with you about this topic. I think this is a very important topic for the U.S. economy and also for the health of the American people. My testimony today reflects my involvement in offshore aquaculture research in New England. However, it's also influenced by my past experience as a commercial fisherman, an oyster farmer, and a seafood business owner. Twenty-five years ago, I was working on a dragger, fishing for cod, haddock, and flounder in the Gulf of Maine. One night when I was at the wheel, I looked out the pilothouse window, and I saw the lights from what must have been 50 other boats, all doing the same thing we were—catching as many fish as we could as fast as we could. It was a life-changing moment for me. I knew that at that level of exploitation, commer-

cial fishing would never last and that there had to be an alternative to hunting down the last fish in the sea. From what we heard from Dr. Hogarth's testimony plus some of the other comments from the panel, it's clear that if we expect to eat seafood, we must agree that aquaculture is here to stay. It's a question of whether the United States wants to be a producer, that we are addressing today. We have done a pretty good job of being consumers of aquaculture products. Now, it's time to decide whether we want to be producers. At UNH, I am part of a team of scientists, fishermen, and aquaculturists, exploring the technical feasibility, the environmental soundness, and economic viability of farming fish and shellfish in offshore environments. Our laboratory is a 30-acre field site, six miles off the coast of New Hampshire where we are putting these questions through the most rigorous of tests in a very difficult open ocean environment. The findings from our research indicate to us that we can build systems that can withstand the worst the north Atlantic has to offer. Native fish species, halibut, cod, and haddock do very well in these environments, and look very promising for commercial production. The offshore mussel culture technology that was developed through our project is a clean, sustainable practice, and it's a tremendous economic opportunity for local and regional fishermen. Our findings are consistent with the results of some of the commercial operations going on in Hawaii, in Puerto Rico, and abroad. However, we do recognize that for this industry to get to the scale where it's going to really solve our seafood trade deficit problems, there are a number of challenges that remain to be addressed. Where are the feed ingredients going to come from? There is a limited supply of fish meal and fish oil. We need to develop integrated farming systems that consider all aspects of culture, including operations such as harvesting, feeding, and issues like worker safety and environmental effects. We need to develop hatchery capacity to produce the juveniles and to develop new species. A number of other challenges exist, however, I don't have time today to mention all of them. These challenges underscore the need for a strategic and comprehensive research and development program, that includes basic and applied research, and demonstration of technologies and environmentally sound operational methods. This is a model that has served the agriculture industries very well, and a model that I believe is appropriate for offshore aquaculture. The Offshore Aquaculture Act provides an excellent framework from which to move forward. I believe, however, that the Act should be further developed to authorize a research and development (R&D) program to support and guide this fledgling industry. Independent, scientifically-verified R&D will make the difference between a successful industry and a struggling one, between one that harms the environment and one that is engaged in systematic environmental protection. It has been nearly a year since the Offshore Aquaculture Act was introduced. Since that time I have heard offshore aquaculture described as the silver bullet to solve all our seafood problems. I have also heard it called an environmental disaster waiting to happen. As a scientist and a citizen, I don't subscribe to either of those opinions. I believe that offshore aquaculture represents a tremendous opportunity for the U.S. I think we also need to recognize that there are and will continue to

be a number of research, technology, economic and environmental issues that need to be resolved. It is clear the world will not wait for us in this matter. Offshore aquaculture is already being developed in the Caribbean, Europe, and Asia. And in some instances, this has been with the benefit of U.S. research and development. I do not believe we should relinquish the fruits of our investments to other nations without first exploring the potential for offshore aquaculture in this country. Nor do I believe that we should rely solely on other nations to develop and regulate an offshore aquaculture industry that will impact the environmental quality of our oceans and the health of U.S. consumers. Thank you.

[The prepared statement of Dr. Langan follows:]

PREPARED STATEMENT OF DR. RICHARD LANGAN, DIRECTOR, UNIVERSITY OF NEW HAMPSHIRE OPEN OCEAN AQUACULTURE PROJECT

Mr. Chairman and members of the Subcommittee, thank you for inviting me to testify on the future of offshore aquaculture in the United States. My name is Richard Langan, and I am the Director of the University of New Hampshire (UNH) Open Ocean Aquaculture Project. I am honored to have this opportunity to inform you not only about the work of our Project, but also to convey my thoughts on a subject to which I have devoted a good part of my life.

Twenty-five years ago, I was a commercial fisherman in the Gulf of Maine. I worked on a dragger, harvesting groundfish like cod, haddock, and flounder. We fished round the clock for several days at a time, dragging our trawl gear over the seafloor, briefly interrupting our "bottom time" every few hours to bring the catch on deck. One night when I was at the wheel, I looked out the pilothouse window and saw the lights from what must have been at least 50 boats, all doing the same thing as ours—catching as many fish, as fast as they could. It was a life-changing moment. It was clear to me that New England's commercial fisheries could not sustain that level of exploitation, and that there had to be a better way to provide seafood and make a living.

At that time, what we now think of as aquaculture was only as blip on the radar screen of global seafood production. Most of the seafood we consumed came from the commercial fishing of wild stocks. That situation has changed dramatically. Many of New England's marine fish populations crashed in the 1990s, and despite severe restrictions on commercial fishing, they have yet to recover. Commercial fishing and all of its related industries—seafood processing, restaurants hospitality, tourism—have felt the pressure. Fishing fleets are underutilized, fishermen are under-employed, and prospects for the future are bleak.

Globally, the catch from wild fisheries essentially has remained unchanged since 1984, despite the proliferation of larger, more efficient boats fishing every corner of the world's oceans. At the same time, demand for seafood has been on the rise. As a result, many countries have turned to aquaculture, which now accounts for roughly 40 percent of global seafood production. Here in the U.S., we consume nearly 17 pounds of seafood per person each year, and more than 70 percent of that is imported. The U.S. trade deficit for seafood now exceeds $8 billion a year, second only to oil as a deficit commodity.

The practice of farming marine fish and shellfish has become part of an international approach to seafood production. Today, U.S. aquaculture takes place almost exclusively in land-based operations or in sheltered, nearshore waters. There is a limit to what these approaches can produce, particularly in coastal waters that are already crowded by other activities. There is also evidence that some nearshore venues may not be environmentally suitable for large-scale finfish production.

The Need for Offshore Aquaculture

There is growing consensus among many scientists, Federal and State marine resource managers, and industry representatives that moving aquaculture offshore could greatly expand our capacity for seafood production and reduce the environmental impacts associated with nearshore aquaculture. It seems shortsighted for the U.S.—in need of a solution to the problem of growing seafood demand and limited supply—not to pursue a sustainable approach to offshore aquaculture. Developed and regulated responsibly, an offshore aquaculture industry could boost the national economy, reduce pressure on commercial fisheries, and provide a secure and healthy food source for the American people.

It has been my privilege to work with a highly talented and environmentally-minded team of engineers, fisheries biologists, ecologists, and social scientists at UNH on this very issue. More than a decade ago, this interdisciplinary team recognized that the U.S. was headed for a seafood supply crisis. Understanding the limits of wild fisheries as a resource, and the constraints on the expansion of nearshore aquaculture, we became one of the first groups in the country to develop research programs that explored the feasibility of offshore fish farming.

A few, small-scale pilot projects in the mid 1990s yielded encouraging results. This led to the concept of an offshore facility, where researchers could work in cooperation with fishermen and industry partners to develop, test, and demonstrate offshore mooring and cage designs, feeding and communication systems, and cultivate native species from wild broodstock.

University of New Hampshire Open Ocean Aquaculture Project

In 1997, fortunate to have the support of Senator Judd Gregg (R–NH), the UNH team received funding from NOAA to establish the Open Ocean Aquaculture Project. At the Project's inception, our goal was to explore the environmental soundness, technological feasibility, and economic viability of farming finfish and shellfish in exposed ocean environments. To this end, we have combined stringent engineering design, progressive fish husbandry with native broodstock, advanced communications technology, rigorous environmental assessment, and community outreach—all in support of the development of an environmentally-sustainable, offshore aquaculture industry in New England and nationwide.

The heart of this Project is a 30-acre field site, six miles off the coast in New Hampshire State waters. The site is fully permitted by State and Federal agencies, just as any commercial venture would have to be. There we raise native finfish species in submersible cages and native shellfish on submerged longlines. All of this takes place in 180 feet of water and is fully exposed to the high-energy environment of the Gulf of Maine. This is where the questions about offshore aquaculture that the Project was created to answer are put to the most rugged of tests. With consistent funding, a dedicated and talented team, and a substantial infrastructure, we have made tremendous strides toward bringing offshore aquaculture closer to commercial reality.

Lessons Learned

After 8 years of offshore aquaculture research and development, environmental monitoring, and economic assessment, our research team has reached some conclusions about the viability of offshore aquaculture.

- Finfish and shellfish culture systems (farms) can be installed, maintained, and operated in the harshest oceanic conditions.
- Farm-raised finfish and shellfish can thrive in these conditions. Halibut, haddock, and cod—all of which we have raised in and harvested from offshore cages—demonstrate excellent commercial potential. With further research to improve growth performance, offshore cod and halibut farming could become commercially viable in the near future.
- Remotely-controlled feeding and observation systems, which have been greatly advanced by our Project's engineering team, are essential to the success of offshore aquaculture.
- With properly sited farms, appropriate system design, and sound management and husbandry practices, the environmental impacts of offshore finfish culture would be negligible. After 6 years of farming fish and shellfish at our research site, we did not detect any changes to the water quality, sediment conditions, or biological communities in the vicinity of our field site.
- The offshore mussel culture technology developed by our Project is a clean, sustainable practice and an economic opportunity for fishermen. The first commercial enterprise using this technology (with assistance from our Project) is a small-scale farm licensed to a N.H. fisherman. This farm is projected to generate $250,000 annually, and we estimate that a modest expansion of this technology in N.H. waters could yield local fishermen $2 million per year. The area from Cape Ann, Massachusetts, to Cape Elizabeth, Maine, could yield as much $40 million per year.
- Based on conservative estimates of the production value per unit area, applying a very small percentage of the U.S. Exclusive Economic Zone (EEZ) toward aquaculture production would go a long way in closing the gap between domestic seafood supply and demand.

Challenges Ahead

Our research indicates that there is tremendous potential for a commercially viable and environmentally sound offshore aquaculture industry in the U.S. This optimism is supported by the success of commercial operations in Hawaii, Puerto Rico, and abroad. However, we also recognize that for this industry to succeed at a scale that will meet current and future demand, significant technical and operational challenges must be addressed. These include the following.

- *Improve efficiency and safety of operations:* Working on the open ocean is challenging and costly. Offshore farming systems, the vessels that attend them, and related equipment all must be designed with efficiency and worker safety in mind. Currently, routine operations, such as cage maintenance and harvesting, require SCUBA diver support. This is expensive and dangerous, even in the best of circumstances. Alternative approaches for routine operations and a greater level of automation and mechanization must be developed and implemented in the U.S.
- *Minimize fish escapes:* The unintentional release of farmed fish is an economic risk for the farmer and—depending on the genetic makeup of the cultured species—a potential risk to wild fish. The U.S. must continue to develop and refine secure, predator-proof containment systems and management practices that minimize the possibility of fish escape.
- *Mitigate potential resource and user conflicts:* Properly locating an offshore aquaculture farm is the critical first step in insuring its economic success, protecting natural resources, and preventing conflict with other activities. The U.S. must develop and apply a systematic, ecosystems-based approach to identifying optimal aquaculture sites in the EEZ. This approach should employ geospatial technology, ocean observing data, and physical and biological modeling and simulation. This should be coupled with environmental guidelines that minimize potential impact on the ecosystems surrounding these farms.
- *Develop hatchery production capacity:* Where will the juvenile fish that stock offshore farms come from? The answer to this question is a classic "chicken and egg" scenario. The U.S. currently lacks hatchery capacity to supply even a modest expansion of offshore farms. At the same time, existing marine finfish hatcheries struggle from lack of customers for their fish. A strategy to maintain and enhance hatchery capacity is vital to offshore aquaculture's commercial development.
- *Secure sustainable feed sources:* Aquaculture relies on a steady supply of raw material to formulate fish feed. Marine fish, in particular, require diets high in protein and lipid content. Currently, these nutritional requirements primarily come from fishmeal and fish oil. Aquaculture accounts for only 30 percent of the fishmeal consumed; the rest is fed to poultry and swine. However it is attributed, fishmeal is a finite resource. The U.S. must identify alternative and renewable sources of nutritionally-appropriate proteins and lipids in support of a large-scale expansion of marine fish culture.
- *Improve production efficiency:* Successful and profitable offshore aquaculture can only be achieved in conditions that are optimal for the fish. Just as with humans, lower stress equals better health. To develop cages, feeds, and feeding schedules conducive to healthy fish, the U.S. needs a more nuanced understanding of the physiological and behavioral responses of fish to their environment.
- *Identify alternative energy sources:* Everyone is feeling the pressure of rising fuel prices, and potential offshore fish farmers are not an exception. The cost of powering offshore farms will have a tremendous impact on the industry's economic viability. This could be offset by harnessing the tremendous power of ocean wind, waves, and currents.

Need for Public Support of Research and Development

The challenges that face an emerging offshore aquaculture industry underscore the need for a strategic, comprehensive program of basic and applied research, and technology development, demonstration, evaluation and transfer. This, in turn, raises the question of whether such a program should be the responsibility of the private sector or the U.S. Government.

Publicly-supported research and development has been essential to the creation and continued success of many U.S. industries. This is particularly true for agriculture. Even in industries that generate the most profitable of commodities, private investment only occurs when adequate scientific evidence warrants economic risk. That the U.S. is a world leader in many agricultural sectors is due in large part

to public support—for research conducted at universities and government laboratories, and for the network of agriculture experiment stations and farms that apply new technologies and demonstrate their usefulness to farmers.

Research and demonstration, coupled with a well-developed system for technology transfer through the agricultural extension service, is a formula that has served U.S. agriculture remarkably well. Aquaculture, in particular offshore, must adopt a similar approach to guide industry development and insure environmental stewardship.

National Offshore Aquaculture Act of 2005

As it has been proposed, the National Offshore Aquaculture Act offers an excellent regulatory and procedural framework from which the U.S. can build a sustainable, offshore aquaculture industry. What the Act now requires is the input of informed stakeholders.

As a scientist immersed in developing solutions to the technical, social, environmental, and economic hurdles that face offshore aquaculture, I believe that Act should be further developed to authorize a research and development (R&D) program to support and guide this fledgling industry. Independent, scientifically-verified R&D will make the difference between a successful industry and a struggling one, between one that harms the environment and one that is engaged in systematic environmental protection.

Such a program would have two components: commercially independent and broadly credible demonstration projects to test the effectiveness of available technology; and competitive, peer-reviewed research funding opportunities to address evolving challenges. This is, effectively, the approach that has made U.S. agriculture the envy of the world—competitive research combined with learning platforms that transfer the fruits of this work directly to those who can apply it to the benefit of the American consumer.

To determine the appropriate levels of Federal, State, and industry investment in this program will require careful planning and discussion. However, it is clear that for such an investment to be effective, it must be commensurate with the challenge at hand. What is it worth to the United States to replace an $8 billion trade deficit with a strong, successful offshore aquaculture industry, one that bolsters the economy and provides a secure source of healthy food? U.S. investments in agricultural technology development and transfer should help us answer that question.

Fortunately, we do not have to start from scratch. The future U.S. offshore aquaculture industry is already supported by NOAA's Sea Grant program, research projects underway at laboratories and universities like UNH, and private sector initiatives. Indeed, last year Congress took a strategic step in leveraging these efforts by appropriating the funds for the UNH Open Ocean Aquaculture Project to become the Atlantic Marine Aquaculture Center. Implicit in this decision is the acknowledgement that while offshore aquaculture is a national issue, it manifests differently at the regional level.

This new center for New England mirrors similar initiatives in the Gulf States and Hawaii. The motivation for these regional centers is a product of local opportunity and need. As such, each plans to work closely with local fishing interests and coastal communities to develop approaches to offshore aquaculture that complement local economies, geography, and culture. At the same time, each will benefit from participating in a national consortium that collaborates to identify bottlenecks to industry advancement, prioritizes research topics, and freely exchanges information and technology.

Closing Statement

It has been nearly 1 year since National Offshore Aquaculture Act was introduced. In that time, an offshore aquaculture industry in the U.S. EEZ has been described as both a panacea for an impending economic crisis and a serious environmental hazard. As a scientist and a citizen, I do not subscribe to either opinion. The research data from our Project at UNH strongly suggests that there is a bright and sustainable future for offshore aquaculture in this country and that it may help relieve pressure on our fisheries. It also suggests that for that to occur, the U.S. must allocate appropriate investments in related R&D and develop sound regulatory oversight with the input of a range of marine resource stakeholders.

It is clear the world will not wait for us in this matter. Offshore aquaculture is already being developed in the Caribbean, Europe, and Asia. And in some instances, this has been with the benefit of U.S. research and development. I do not believe we should relinquish the fruits of our investments to other nations without first exploring the potential for offshore aquaculture in this country. Nor do I believe that we should rely solely on other nations to develop and regulate an offshore aqua-

culture industry that will impact the environmental quality of our oceans and the health of U.S. consumers.

Senator SUNUNU. Thank you very much, doctor. Mr. Cates, welcome.

STATEMENT OF JOHN R. CATES, PRESIDENT, CATES INTERNATIONAL INC.

Mr. CATES. Thank you, Chairman, members of the Subcommittee. Thank you for having me here. It's a great honor for me to come here a long ways from Hawaii. I am owner and President of Cates International. I am the hundred percent owner of the company. I have an operational commercial fish farm in Hawaii, as many of you know. It's quite interesting to note in your opening remarks about submerged cages, our company has developed that and was the first one in the U.S. to do such and to have an open ocean lease. We currently have raised over a million pounds. My former job as a commercial fisherman—it is a monumental task what it would have done for me to have taken that from the wild, and I cannot explain or express the feeling that I get from not taking from the wild any longer. It's a feeling of—that I can see longevity in my career now whereas a commercial fisherman, I was constantly looking at getting out of the industry because it was going to be short-lived. All of us here today in this room are concerned about the health and well being of our oceans. And as we talk about these issues, I look forward to answering some of the questions from an operational side. But I also would like to note that we need to think about the health and well-being of our communities and our society. An example that I use in many of my talks is about my father-in-law who is native Hawaiian from the island of Hawaii. He was raised in a very rural area, raised mainly on vegetables and fish. And on his 18th birthday, is when he had his first steak. And in a single generation, his diet and my wife's diet completely changed, and that has significant health implications for many of the people in Hawaii. As Senator Inouye will know, we have a health issue. Their bodies have been engineered to eat in a certain manner, and it's completely changed. Our fishery has changed. Hawaii is a window to the future of the rest of the country. Our nearshore fisheries have been depleted. Yet, we have strong offshore fisheries that are relatively healthy. We need to recognize, as the Hawaiians did thousands of years ago, we have to farm our fish. So, I implore this subcommittee to take that into consideration as we also discuss the health and well-being of our oceans. Prior to me coming here, I asked my community and some very important members who I trust what they thought about this bill, including the Governor of our state. She has authorized me to state—that her intention is full support of this bill, and I have not heard any opposition, although I would have two simple recommendations. The first, as an investor in this business, I am concerned about the 10-year lease being too short. I—even though I invested my own money into offshore fish farming, I would not invest in an EEZ if I only had a 10-year lease. It's just too short for that level of investment. And the second is a state's opt-out, and the reason I am concerned about that is—it's for the same issue, whether you invest in this and—you invest in the industry, wheth-

er a state can just pull the plug and leave without—because of political and not environmental reasons. I hope this subcommittee will consider the importance of all these issues. As I look at my newborn son, I hope that he can be raised on a diet of fish and vegetables and a healthy diet that closely resembles his ancestors and all Americans. This is a bill that is for all of Americans, not just certain coastal communities. Clearly, farmed fish is of major importance, and we need to look at the success of farmed salmon. A lot of people look at it as a negative thing, but I look at it as a success. Salmon is available year-round to many Americans at a reasonable cost. Seafood should not be just for the wealthy. We need to find ways to get it down to the people that really need it the most and who are going to benefit the most. And I look forward to any questions, and I thank you very much.

[The prepared statement of Mr. Cates follows:]

PREPARED STATEMENT OF JOHN R. CATES, PRESIDENT, CATES INTERNATIONAL, INC.

Aloha Ladies and Gentlemen,

I am greatly honored to have been asked to provide testimony and share my personal experience regarding offshore aquaculture. The responsibility of this subcommittee is an important one, as is the legislation regarding our oceans. As you navigate through the input regarding this issue, I have faith that the Nation's best interest will prevail.

I was born and raised in Hawaii, on the Island of Oahu. My first employment opportunity concerning marine life and the ocean began at the age of 15 when I started training dolphins for the United States Navy out of the Kane'ohe Marine Corp Base. Training mammals for the Navy allowed me to travel to many parts of the country and I was exposed to vast and diverse ocean conditions. In 1991, I became a contractor for the United States Defense Intelligence Agency, and although I did travel a good amount, this opportunity allowed me to do commercial fishing whenever at home. Throughout the 1990s, I became interested in research projects regarding marine environments and fisheries, and as a result, created a business to support research by providing ocean vessels, equipment, and manpower. This led to my involvement with the Hawaii Offshore Aquaculture Research Project (HOARP), which conducted research into the feasibility of open ocean aquaculture. My experience with, and the success of, this research project opened up my eyes to the realization that we can farm our seafood and do it in an environmentally sustainable manner while protecting our wild fish stocks. It was apparent then, just as it is today that the longevity of commercial fishing in my area will be short-lived.

With the success of the HOARP project, it became apparent that commercial success of open ocean aquaculture in Hawaii would require changes to State laws and legislation. John Corbin with the Aquaculture Development Program (ADP) in Hawaii, along with a coalition of players and pioneers in the industry, were instrumental with the implementation of Chapter 190D, Hawaii Revised Statutes, addressing ocean and submerged land leasing that ultimately allowed utilization of Hawaii's ocean resources for research and sustainable development of open ocean aquaculture. In essence, this Hawaii statute is very similar to the Administration's bill regarding offshore aquaculture in Federal waters. Many of the concerns being raised now are similar to concerns that were raised back in 1999 in Hawaii. Amendments made to Chapter 190D allowed our company, Cates International Inc., to become the first business in the United States to be issued an open ocean lease for mariculture. Being the first was not easy, nor should it have been, and I continue to feel a personal responsibility for how this new industry develops both in Hawaii and in the U.S. We have much to offer, and I personally share experiences and learning lessons with the public as often as the opportunity presents itself.

There are many lessons to be learned from processes developed for the aquaculture industry in Hawaii. A fundamental lesson is that open ocean fish farming does work, and that it can be done without causing significant effects upon the environment. In fact, environmental changes associated with habitat creation have been seen as an environmental benefit. The Environmental Assessment (EA) process in place has proven to be adequate and successfully addresses concerns posed by the community. Our strict EA process forces potential companies to engage and meet with their communities and make themselves available to be questioned and chal-

lenged. While there are currently two successful companies operating in Hawaiian waters, there have been multiple attempts by potential companies to obtain leases, however, they were not able to satisfy regulatory standards due to inadequate planning and knowledge and their applications were therefore denied. This is testament that our community's expectations are high and that their concerns are being legitimately addressed. Another important aspect of the EA process is having a lead agency, such as the Aquaculture Development Program, which is essential in helping to create a straight-forward system to assist companies and investors. In addition, a Federal agency such as NOAA is vital in having the authority to issue such leases. A compilation of State, Federal, and community resources is a fundamental and important marriage in the creation of an EA process that works.

During our EA process, many concerns were raised. Some were valid and some were not, many were scare tactics fueled by misinformation, however, all were addressed. In Hawaii, we have made great strides in educating our communities and public about our industry, and continue to do so. This commitment will be ongoing on our part.

Environmental issues are a huge concern in our industry and there are safeguards in place. Hawaii legislation mandates that only indigenous fish be stocked in any offshore cage. It is my opinion that this is an important and sensible safeguard, but if a particular species could be grown without the possibility of causing harm to the wild sector, I think this should be looked at on a case-by-case basis. For example, if a certain species was proven to be sterile prior to being grown in an open ocean fish farm, thus eliminating the possibility for reproduction, this could be a consideration. Currently however, farming species native to the area is the safest approach to this issue.

Regarding the issue of disease, open ocean fish farming must face these issues just as traditional land-based farms. Like all farming, we are always on the lookout for disease; we check for disease prior to putting the fingerlings into the offshore cages and diseases endemic to the environment will have to be managed at the farm level through careful monitoring of the fish stock and perhaps through crop rotation, limitation of crop density, or by pre-approved vaccinated stock just as is done in any farm where animal husbandry is practiced. My experience with disease however is limited. We have been in business for 7 years and harvest upwards of 8,000 pounds of fish per week, and we have not had issues with disease.

As this subcommittee and the Federal Government try to create a regulatory body for permitting, it is my belief that if the Federal Government needs to follow a path similar to that of Hawaii, the permitting process will likewise eliminate the potential for "bad actors." I am confident in the process and oversight of offshore fish farming in Hawaii; there is currently an adequate system of checks and balances. We are a self-regulated as well as a state and federally-regulated industry, and I am concerned that any further regulation will deter investment into offshore fish farming by making the permitting process too cumbersome and slow. Presently, the permit process has proven to weed out weak companies and the EPA and other agencies that currently regulate our industry are sufficient. I am 100 percent owner of Cates International Inc., and purposely put my family name in the company's title because I believe in and endorse all that we do completely. My community can be assured that I will not allow my operations in any way to harm the environment. I am also confident that as other new companies are permitted that they will have to follow the same regulations that I do. We as an industry do not want this to be an easy process; we want to ensure that adequate standards and regulations are in place to protect all we have invested and I am fully confident that the current regulations in place are sufficient.

Today, offshore leasing for reasons other than aquaculture, such as alternative energy and ports, is foreseeable and there are concerns that these leases may unfairly disadvantage or damage aquaculture operations. However, aquaculture as an industry has the right to expect that permits issued to other operations will not jeopardize its own operation or cause environmental damage. In fact, aquaculture would presume that permits would not be given to any operation that would impact the environment in such a way as to cause harm to aquaculture stock. Issues, therefore, could be directed to use of space. However, the Exclusive Economic Zone, or EEZ, is almost the same square miles as is the land area in the continental U.S. so a conflict with other structures over use of space seems improbable. According to calculations done recently by Dr. John Forester for NOAA, "Looking much further ahead, an industry producing two mmt [million metric tons] per year (NOAA's projected additional deficit by 2025) would require about 10,000 acres of surface space for cages and 350,000 acres for placement of multiple anchors. These areas represent about 0.003 percent and 0.01 percent of the U.S. EEZ respectively and only 0.2 percent and 6.8 percent of the 11.9 million acres that are already allocated to

marine sanctuaries. As noted earlier, two mmt of seafood per year produced by aquaculture represents about $5 billion of imports and 150,000 direct and indirect jobs based on today's metrics."

Issues with mobile users of leased space, such as ships and fishermen, seem at first glance to be more of an issue. However, if such aquaculture operations are not permitted in or near shipping lanes or commercial fishing grounds this concern is alleviated. Also, operations should have to meet all of the lighting and safety standards and have proper navigation aids for standard ocean safety practices. We must keep in mind that these aquaculture operations, though they may seem large in scale, are actually miniscule when put in an ocean environment. For example, in Norway their fish farming industry exceeds over $1 billion a year, but the footprint of all of the sea cages combined for this industry is smaller than most runways at our large airports. The open ocean is immense and fishing vessels will have ample room to go around such areas. Likewise, we have many marine protected areas and large bodies of water that fishermen are prohibited from entering, such as sanctuaries, and there is no problem there.

As this subcommittee considers legislation regarding open ocean fish farming, it is important to note what current research needs are, and what they will be. It will not make sense to pass such legislation unless we are willing to invest in this new industry, thus relieving pressure both on our wild stocks and on the trade deficit. The current level of funding available for research in offshore fish farming, to my knowledge, is less than $5 million per year, and I strongly believe that we will need a level of around $50 million per year to adequately satisfy needs on a national level. There is a sufficient level of funding for commercial venues to build new fishing vessels, but inadequate levels available for aquaculture ventures. This shortcoming needs to be addressed and fairly balanced.

At the same time, I strongly believe that the aquaculture industry should also be investing in research as well as other areas that we will directly benefit from. I feel some of the areas that industry should be responsible for are:

- Harvesting techniques which will be species and site specific
- Vessels used for daily operations
- Operational gear
- Marketing

However, there is a long list of areas that I feel our government could and should play a role in assisting the offshore industry in research and development. I have often been told that the three rules to a good business are location, location, and location. This is also applies toward offshore fish farming; however, in reference to open ocean fish farming, I would argue hatchery, hatchery, hatchery. Nationally, we are not leaders when it comes to hatchery technology or species development and this area is vital! A successful fish farm is dependant upon a successful hatchery. I have found that other areas in need are development and testing of feedstock alternatives, deep water mooring systems, disease prevention, and research into new fish species.

I have been asked what the realistic expectations are that aquaculture can do for the U.S. regarding economic returns, food supply, and balance of trade. My response to this question is that I personally feel that if this legislation is implemented, we won't see an investment into salmon farming in the EEZ, but we will see an investment into new species, and most likely in the warmer water climates of the U.S. While a lot of opposition for this bill comes from Alaska fishermen, I seriously doubt that anyone would invest in the EEZ in Alaska. The environment there is very tough, and although it can be argued that it is tough anywhere in the U.S., it is doubly tough in Alaska. If it were to occur at all in Alaska, it will happen in State waters because of favorable working conditions. If the legislation encourages investment from the private sector, I predict a slow start, approximately 2–4 years and we will possibly see several farms. But as we as an industry prove to ourselves and to others what our capabilities are and what the benefits that come along with it are, there will be significant growth. In Hawaii, we currently have invested nearly $11 million between two farms, Cates International Inc. and Kona Blue Water, exclusively from the private sector, and I believe that we have the potential to be a $100 million a year industry within the next 7 to 10 years. For the rest of the country, it really depends on two significant factors—first, whether or not upcoming legislation encourages investments without overburdening constraints, and second, whether or not the Federal Government seriously invests in research (*e.g.,* hatchery development). To put this in perspective, in Hawaii, it is doubtful that we will venture into the EEZ in significant numbers due to the depth of water, but for the rest of the country, it will most likely have to occur in the EEZ due to the shallow water conditions near shore.

In 1999, many in Hawaii predicted open ocean fish farming would be an ecological disaster. These concerns led both State and Federal Government agencies to research and investigate the negative impacts of fish farming on our site, and nearly 6 years later, no negative impact has been found. On the contrary, although no funding has been provided to research positive impacts, it is readily apparent that there has been much. Positive impact is evident in our production numbers; we have been able to raise over 1 million pounds of fish that would have otherwise been taken from the wild by commercial fisheries. This has been done in an area of approximately two acres which consisted of only a sandy bottom habitat (no fish were observed during site surveys prior to farm development). This area is now home to a vast and diversified ecosystem. In fact, some of the very individuals that raised environmental concerns now benefit directly from our site and routinely fish the area. Our community also benefit with fresh, local, farm raised fish available year round that is not affected by limited fishing seasons. We raise Hawaiian moi, a fish once reserved for Hawaiian Ali'i or Royalty and a fish that was nearly extinct in the wild. It is now available to everyone at an affordable price. I have often been thanked by members of our elderly community, many of whom were raised eating this particular fish and can now enjoy eating it again.

Our local chefs and restaurants also benefit by having a fresh, locally grown product available year round. In Hawaii, the term "farmed raised" is positively used in advertising and marketing, and many of the top chefs and restaurants overwhelmingly endorse our company and product. As an employer and fish farmer, I have financially been able to increase the income of my employees nearly 70 percent, and we go home to our families every night. All of these reasons, in my opinion, are positive impact and have never been measured by opponents of aquaculture.

In conclusion, as this subcommittee evaluates whether to allow offshore aquaculture facilities to operate within the U.S. Exclusive Economic Zone, I am reminded of a lesson I learned very early in life. My father, who was also born in Hawaii, was very involved with Hawaiian canoe paddling and when I was a young child at the age of seven, he would take me out on the ocean with his canoe team. A well respected, strong Hawaiian man by the name of "Cappy" was teaching me how to steer a canoe, and I once asked him how do you know where you are going once it gets dark. He said "If you don't change course, you will end up were you are heading." Simple words spoken by a true Hawaiian man. We as a Nation know where we are heading with respect to our fisheries; we are all aware of the enormous demand for seafood, and the pressure that places upon our wild stocks. NOAA and the National Marine Fisheries Service have done a good job in identifying what course we are on and have made good recommendations on what needs to be changed. It is now time to change direction and that responsibility lies with this Committee. Change is not easy—it never is, but I am confident that when presented with all of the information, this Committee will make the right decision and support this legislation for the benefit of all Americans and our oceans. The ocean and the EEZ is a public resource, and the American public deserves to have fresh fish that is affordable, both wild and farmed.

I sincerely thank all of you for taking the time to listen to my testimony and for inviting me to take part in this historic step in the world of aquaculture. I truly believe that this will put us all in a better place during a time that we as a society are consciously trying to live healthier, and I am thankful that I could play a small part in a monumental Act that will benefit the generation of my young son, as well as those to come.

Mahalo.

Senator SUNUNU. Thank you very much, Mr. Cates. Mr. Vinsel, welcome.

STATEMENT OF MARK VINSEL, EXECUTIVE DIRECTOR, UNITED FISHERMEN OF ALASKA

Mr. VINSEL. Thank you, Mr. Chairman and members of the Subcommittee. The United Fishermen of Alaska represents 31 Alaska commercial fishing organizations from throughout Alaska, the Bering Sea, and the Gulf of Alaska. We represent roughly half of the United States domestic seafood production. We don't have any depleted stocks. I think our experience in our science-based management is very different from the two former commercial fishermen that you heard speak. There is a lot of misunderstanding about

Alaska's well-known ban on finfish farms. It is not in opposition to all aquaculture. Even among UFA's 31 member groups, seven of them are nonprofit aquaculture associations that raise salmon fry and smolts and release them into the wild. And they are then a common property resource available for not only commercial, but sport and subsistence harvests. And those are done with science with the guidance of the Alaska Department of Fish and Game in harmony with the natural stocks and result in a sustainable salmon stocks with the last 2 years—having been in the top 4 years of all history. Our fisheries with science-based management, we consider it like mowing the lawn. You do have to mow the lawn or else it'll kind of go to weeds, but cutting the grass every year doesn't cause a problem to your lawn. It is common to hear of the talk of fishermen as the last of a vanishing hunter gatherer tradition that is on its way to extinction, to be replaced by agrarian food producers. But to us, there is a big difference between land- and water-based agriculture. Husbandry of terrestrial ecosystems has clearly provided increased food production. But in healthy ocean systems, we don't think that man's best efforts can make any net gain. Feeding fish to other fish as done in finfish-based net pen agriculture or aquaculture is not a net food production increase. Wild salmon depend on the pasturage of the open oceans, and putting netpen fish farms in the open ocean will interfere with the wild fish food chain. Where healthy oceans exist, they are worth saving. Where waters have been impaired, priority should be given to restoration of healthy natural systems that can sustain the progression of life for productive fisheries as consideration is given to fencing them off for fish farms. If the goal is to increase production and consumption of domestic seafood, a sizable gain could be made with an investment in basic infrastructure in Alaska communities and attention to the rebuilding of the Gulf of Mexico coastal communities in a planned way to retain the most value in wild seafood harvests. Arguments that the United States needs to promote finfish agriculture technology to help our balance of trade are belied by history in fish markets and current trends in all industries that require labor. Finfish aquaculture technology was developed by U.S. universities, then adopted by other countries where lower costs of labor and lesser environmental restrictions allow producers a lower cost of production than possible in the U.S., and imports have swamped U.S. domestic producers whether they are salmon, shrimp, or catfish farmers. Those three U.S. domestic producers were the three initial product categories that qualified for USDA Trade Adjustment assistance. There were really no major agricultural commodities in the first 2 years of that program. Other than Maine wild blueberries and Florida lychee fruit, it was salmon, catfish, and shrimp when the USDA decided that we needed to have a temporary adjustment program to help with the spike in imported production.

The North Pacific Fishery Management Council has a good track record of looking into the science and economics of fisheries and taking a precautionary approach. We insist that the Council have authority, not merely consultation because the Council is—effectively governs our ocean systems and our fisheries, and we need them to have the authority on that. We also look for a serious

study of the social and economic effects, as included in Senator Murkowski's amendment 1727 before this moves forward. The ability of a state to modify aquaculture practices to fit the unique circumstances is—needs to be effectively coded in this legislation. The Senate can delegate authority of aquaculture permitting to the states, and this needs to be clear and incontrovertible language in the bill. Species that do not occur naturally in an area should not be considered and neither should genetically-modified fish. They will escape with unpredictable consequences to the local ocean. Farmed fish can and must be marked, every one, by scientifically valid methods that are very economical, such as thermal otolith marking to ensure that any escaped fish can be attributed to their producer. In the future, there may be a place for aquaculture in maintaining healthy oceans, but current technology does not adequately protect existing ocean resources from harm from fish farms seeking to grow fish to market size in coastal or ocean waters. It may be worthwhile to look at the model of Alaska's salmon aquaculture programs to raise and release fingerlings with the emphasis on enhancing rather than replacing natural stocks for a common property resource available to all and to help restore diminished fish stocks with long life cycles and extended predicted rebuilding times for the benefit of all Americans. These operations must be consistent with ecosystem-based management based on sound science and a precautionary approach. Please be very cautious in your drafting of regulations and heed the old saying, please, first, do no harm. Thank you.

[The prepared statement of Mr. Vinsel follows:]

PREPARED STATEMENT OF MARK VINSEL, EXECUTIVE DIRECTOR, UNITED FISHERMEN OF ALASKA

United Fishermen of Alaska (UFA) represents 31 Alaska commercial fishing organizations from fisheries throughout Alaska, the Bering Sea, and Gulf of Alaska, with fishermen from 46 states, accounting for almost half the domestic seafood production of the United States. I am Mark Vinsel, Executive Director of UFA. I also serve as Chairman of the Alaska Fishing Industry Relief Mission, a volunteer effort to provide assistance to the Gulf of Mexico fishing industry in the wake of last summer's hurricanes.

We thank you for the invitation to share our point of view regarding offshore aquaculture and hope that our concerns will guide you in establishing a framework for offshore aquaculture management that will be a benefit to the Nation's food production, while sustaining healthy oceans and recovering depleted or diminished stocks for the benefit of all.

There is much misunderstanding of Alaska's well-known ban on finfish farms. It is generally viewed as opposition to all aquaculture. However, Alaska has viable aquaculture operations that produce a variety of shellfish and enhance our natural salmon runs.

The connotations around the term *aquaculture* have largely come to mean "farm," as it is in S. 1195. There is much more to the term than that. Alaska's nonprofit regional aquaculture associations release immature salmon as fry or smolt, from coastal bays where there are few or no resident salmon and no identifiable interference with returning natural wild stocks. From the point of their release on, the immature salmon are a common property resource, ranging freely, subject to natural environmental conditions and available for commercial, sport, subsistence and personal use harvests. The intention of Alaska's aquaculture program is to augment, not replace natural stocks, especially during years of lower than average returns. The success of this program is illustrated by the abundance and health of Alaska's salmon populations with recent yearly returns at all time high levels.

It is common to hear talk of fishermen as the last of a vanishing hunter gatherer tradition that is on the way to extinction, to be replaced by agrarian food producers. We feel there is an unarguable difference between land- and water-based agri-

culture. Man's husbandry and manipulation of terrestrial ecosystems clearly has provided increased food production, but in healthy ocean systems it is questionable if a real gain of production could be obtained through man's best efforts. In healthy oceans there are no fences and all biota feeds and is fed upon, creating an integrated food web. This food web produces fish that are a high-quality protein with great flavor and nutrition. Free-range wild and enhanced salmon harvests depend on the flux of this fluid web of life. Introducing large scale net pen operations would inevitably draw from the natural pasturage available to wild fish.

Wild salmon depend on this pasturage. Large scale fish farms will interfere with their physical presences as well as interdicting the food web which is the sustaining pasturage of viable wild stocks. Precedence has to be given to healthy wild stocks where they exist. Fishermen that have learned to shepard their fisheries to harvest responsibly and sustainably deserve the opportunity to continue.

Where healthy oceans exist, they are worth saving. Where waters have been impaired, priority should be given to restoration of healthy natural systems that can sustain the progression of life for productive fisheries, as consideration is given to fencing them off for fish farms.

We see a big difference between free-ranging fish and sedentary mussels growing on ropes, and so far the economic results affirm the viability of the mussel production as a form of aquaculture that can benefit local fishermen and their communities and coexist with existing fisheries. Large scale finfish operations in net pens bring much greater risk and would provide less economic benefit to coastal communities, especially in coastal Alaska where infrastructure is the impediment to getting our fish to market, not a lack of fish.

Arguments that the United States needs to promote finfish agriculture technology to help our balance of trade are belied by history in fish markets, and current trends in all industries that require labor. Finfish aquaculture technology was developed by U.S. universities then adopted by other countries where lower costs of labor and lesser environmental restrictions allow producers a lower cost of production than possible in the United States, and their imports swamped U.S. domestic producers be they salmon fishermen or catfish farmers. It bears noting that in the USDA Trade Adjustment assistance program, U.S. catfish farms and shrimp farms, along with salmon producers from AK, Washington and Oregon were qualified for benefits to compensate from the market effects of increased imports while Maine blueberries were the only non-seafood crop that qualified in the first year. The differences in labor and environmental costs will continue to favor low-cost foreign producers, with little likelihood of erasing the seafood balance of trade.

If the goal is to increase production and consumption of domestic seafood, a sizable gain could be made with an investment in basic infrastructure in Alaska communities, and attention to rebuilding Gulf of Mexico coastal communities in a planned way to retain the most value in wild seafood harvests.

There is no fish farm technology that can more cheaply produce the "superfood" that is Alaska's pink salmon—for which last year's average dock price of 12–14 cents per pound was a strong uptick—and which is proving to be an important source of non-perishable quality protein in government aid programs as we speak.

We recommend that with whatever direction domestic high seas aquaculture development takes, equal attention be paid to protecting existing seafood production. Market impacts should be studied for individual projects. In many coastal communities, there are no other job opportunities available to displaced workers so operations that have the potential of interfering with existing fisheries need to be carefully assessed before damage is done.

Local scientific input is needed in permitting and location. A fish farm operator might desire to utilize areas of natural upwelling to benefit from the availability of a natural free food source. The ocean environment is fluid and dynamic, and every component of the food chain is a necessary component in this complex web of life. We are concerned that placement of large scale fish farms in areas of open ocean would rob the existing web of life in unpredictable ways.

The North Pacific Fishery Management Council (NPFMC) has a good track record of looking into the science and economics of fisheries, and taking a precautionary approach to opening new fisheries and management concepts. They have made difficult decisions and set harvest levels in favor of maintaining stock viability over short-term economic gains, and the NPFMC has been party to setting aside large tracts of ocean to be protected from direct fishing activities. The sensitivity of oceans are considered and the very fact of human activity has been deemed a significant impact to the ocean's sensitivity. The NPFMC has a proven track record of good judgment and is the only forum in place for prudent management of the Gulf of Alaska and Bering Sea. Fishermen will be affected by location and operation of fish farms in areas where they fish or travel. The regional councils should hold manage-

ment *authority* over fish farm operations, with consideration for the social, environmental and economic effects upon ocean resources and existing users, not merely *consultation* as included in S. 1195.

Should offshore aquaculture be allowed in U.S. marine waters, fishing businesses and coastal communities need to be considered, and must be allowed to compete on a level playing field in the marketplace. Salmon, halibut, sablefish, and other species that compete with farm raised product need to enjoy access to the same types of research, marketing and support programs provided by the Department of Commerce and Department of Agriculture for fish farm operations.

The ability of a coastal state to modify marine aquaculture practices to fit unique circumstances or to opt out if the state deems the aquaculture activity to be unjustified must be effectively codified within the legislation. The U.S. Senate can delegate authority of aquaculture permitting to states, and this needs to be clear and incontrovertible.

UFA supports S.B. 2859, which has been re-introduced by Senator Murkowski as Senate amendment 1727 to S. 1195, calling for serious study of the social and economic effects before offshore aquaculture is considered.

The precautionary principle is the concept of proving no identifiable harm before implementing substantial changes, and is a fundamental tenant behind Alaska's fisheries resource management. The cost of altering a project or not moving forward with a proposed change, to prevent damage, is far less than trying to restore damage that is already done.

The U.S. Commission on Ocean Policy, and Pew Oceans Commission, both pointed to the need for ecosystem-based management, and called for increased funding for ocean science to better understand these highly dynamic systems. Meanwhile, climate and regime changes are occurring that compound the difficulties in obtaining this baseline science. To introduce large-scale aquaculture to these ocean systems without thorough scientific understanding in place to gauge the effects as they occur is irresponsible. It is very troubling that S. 1195 contains so much consideration for existing offshore oil platforms and so little language on the environment into which the farms are to be introduced.

Progress has been made in some areas of large scale fish farming that were troublesome. Antibiotics are not as widely used in technologically-advanced aquaculture operations, having been replaced by vaccines that are cheaper and more effective. And it may seem that the concentration of wastes may be less of a problem in the open ocean than they are in nearshore environments. But the oceans are not limitless and in large scale operations the effects may not be as noticeable but are there nonetheless. The Pew Oceans report noted that the cumulative effects of many sources of non-point source pollution are a huge problem to ocean health, and introduction of large scale fish farms would further this problem. A further problem with cumulative non-point source pollution is that it precludes any meaningful concept of responsibility. Waiting until the fish are gone, then trying to figure out who to blame does not protect the fish. At a minimum, fish farms need to have proven standards which substantially reduce risks before permitting.

Near shore fish farms continue to suffer from increased parasites such as sea lice with harm to naturally-occurring fish stocks that pass through the area. With a tremendous increase in investment in science required for ecosystem-based management, we may someday be able to pick a site for a fish farm where we can safely assure that no natural fish will be affected, but we are a long way from that level of knowledge now. We feel that the potential environmental impacts justify a thorough legislative environmental impact statement.

There should be no exemption from existing labor laws and applicable regulations concerning transportation such as the Jones Act, and no bypassing of regulatory framework in place for our coasts and oceans.

The term "Exclusive Economic Zone" clearly should preclude foreign ownership.

Species that do not occur naturally in an area should not be considered, as they will escape with unpredictable consequences. Farmed fish can and must be marked by economical but scientifically-valid methods such as thermal otolith marking to ensure that any escaped fish that cause harm can be attributed to their producer.

In the future, there may be a place for aquaculture in maintaining healthy oceans, but current technology does not adequately protect existing ocean resources from harm from fish farms seeking to grow fish to market size in coastal or ocean waters. It may be worthwhile to look to the model of Alaska's salmon aquaculture programs to raise and release fingerlings with the emphasis on enhancing rather than replacing natural stocks, for a common property resource available to all, and to help restore diminished fish stocks with long life cycles and extended predicted rebuilding times, for the benefit of all Americans. These operations must be consistent with ecosystem-based management based on sound science and a pre-

cautionary approach. Please be very cautious in your drafting of regulations for the permitting of offshore aquaculture, and heed the old saying—*first, do no harm.*

Senator SUNUNU. Thank you very much, Mr. Vinsel. We are also joined by Senator Snowe of Maine. And before continuing with Dr. Goldburg, I want to give Senator Snowe a chance to make any opening remarks she might have.

STATEMENT OF HON. OLYMPIA J. SNOWE, U.S. SENATOR FROM MAINE

Senator SNOWE. Well, thank you, Mr. Chairman, and I certainly thank you for convening this hearing today on offshore aquaculture. It's certainly a critical issue for my state, and I'll ask unanimous consent to include my entire statement in the record——

Senator SUNUNU. Without objection.

Senator SNOWE.—but I do want to recognize Mr. Sebastian Belle, who is here today from the State of Maine and head of the Maine Aquaculture Association. We have certainly had long-standing experience with aquaculture in the State of Maine, and I think it is important to look at specific legislative proposals for regulating fish farming. We have certainly been able to draw on our experiences in the state and we know how important it is going to be for the future of our industry—and important for the seafood industry as well. So, I appreciate the fact that you are holding this hearing here today because I do hope that we can determine what would be the best legislative initiatives to develop. We must respond to the issues concerning the problems that have stemmed from fish farming and identify what we can do to ensure that we preserve this vital industry for the state. We have more than 150 operations in the State of Maine that yield more than $80 million annually. So, it is a critical industry, and we want to be sure that we do everything we can to maintain and preserve the future of this vital industry for my state and this country. Thank you.

[The prepared statement of Senator Snowe follows:]

PREPARED STATEMENT OF HON. OLYMPIA J. SNOWE, U.S. SENATOR FROM MAINE

Mr. Chairman, I thank you for convening today's hearing on offshore aquaculture. The State of Maine has decades of experience in fish farming, especially in near-shore state waters, and we recognize that this industry could soon have new opportunities to pursue aquaculture in offshore, Federal waters. Therefore, this timely hearing will help ensure that Congress understands the issues and challenges facing this emerging industry, so we can authorize an appropriate Federal framework for developing and promoting offshore aquaculture.

Before we discuss the specific issues of the legislative proposals for regulating fish farming, we should take a step back and look at the global dimensions of seafood production and demand. The United Nations tells us that 60 percent of the world's fisheries are either depleted or fully exploited, yet global demand for seafood—a healthy source of protein—continues to grow, perhaps up to 70 percent in the coming decades. Not surprisingly, the world is looking to aquaculture to meet this ever-increasing demand.

While many countries, especially in Asia, have developed aggressive policies promoting fish farming, the United States has not kept pace. Less than 40 percent of our seafood is produced domestically, making the U.S. very reliant on imported seafood—a majority of which comes from foreign aquaculture. This makes it possible for us to enjoy easy and affordable access to our favorite seafood dinners, but this convenience and nutrition does not come without costs.

For example, after several decades of industrial aquaculture around the world, we have seen that large-scale fish farming may lead to marine pollution and habitat

loss if it is not done correctly. Fish raised at high densities can also transmit disease more easily, which may necessitate the use of antibiotics and other medicines. And considering that many farm-raised species have limited genetic diversity, they can expose wild stocks to a host of risks—from interbreeding or co-mingling of wild stocks with potentially unhealthy fish.

The experience of aquaculture in Maine has cast a spotlight on many of these issues, but at the same time it provides examples of how the industry can address and overcome problems like disease and escapement. Today, nearly 150 aquaculture operations in Maine grow Atlantic salmon, oysters, mussels, and other commercially valuable seafood, growing products worth more than $80 million annually. As a pioneer in this field, Maine is finding ways to create jobs in coastal communities and sustain a vital component of the seafood economy, and ongoing research is pointing to new ways to support this industry's expansion.

Despite these potential challenges, the economic and public health benefits that could accompany aquaculture and the value of it in Maine make it worthwhile for us to consider the future of this industry in the United States. Currently, there is no Federal framework specifically designed to address the unique regulatory issues surrounding offshore aquaculture, so in building one we must seek to prevent the mistakes and shortcomings of the past from being repeated. The Administration's proposed bill for offshore aquaculture moves us in this direction, as it proposes a number of criteria aimed at ensuring environmental protection and sustainable fish farming development.

It is now our responsibility to critically examine this proposed bill, listen to the expert testimony provided to us today, and chart a way forward through these complex—and potentially controversial—issues. I am impressed with the caliber of the panel assembled here today, and I thank all the witnesses for appearing—Dr. Bill Hogarth of the National Marine Fisheries Service; Dr. Richard Langan of the University of New Hampshire; Mr. Randy Cates, President of Cates International, all the way from Hawaii; Mr. Mark Vinsel of the United Fishermen of Alaska; and Dr. Rebecca Goldburg of Environmental Defense. And of course, I am very grateful that our Chairman has invited Sebastian Belle, Executive Director of the Maine Aquaculture Association, to testify before us today. Sebastian, I am confident that your testimony will shed light on many of the key issues in the already complicated state-Federal regulatory environment of this industry.

Thank you again, Mr. Chairman. I look forward to hearing the testimony and working with you on this critical legislation.

Senator SUNUNU. Thank you very much, Senator Snowe. Dr. Goldburg, welcome.

STATEMENT OF REBECCA GOLDBURG, PH.D., SENIOR SCIENTIST, ENVIRONMENTAL DEFENSE

Dr. GOLDBURG. Thank you very much. I am honored to have the opportunity to testify today. And as you noted Mr. Chairman, I am a biologist and Senior Scientist with Environmental Defense, a national nonprofit organization. My testimony will focus on environmental concerns with offshore aquaculture and aquaculture legislation. Environmental Defense supports aquaculture as a means to increase seafood supplies. Nevertheless, pursuing aquaculture development without adequate safeguards may be worse than not pursuing aquaculture at all. Although aquaculture and capture fishing are sometimes viewed as separate endeavors, the future of some aquaculture sectors is intertwined with fisheries and the health of marine ecosystems. Offshore aquaculture is patterned after salmon aquaculture and could be expected to have somewhat similar impacts. Like farmed salmon, finfish raised offshore will be housed in net-cages, which sit directly in marine waters and are vulnerable to at least four types of environmental problems. One of these is escaped farmed fish. Ecological damage caused by escaped farmed fish include the introduction of non-native fish species and reduced so-called fitness of wild fish as a result of inter-

breeding with escapees of the same species. The likelihood of large-scale escapes from offshore farms is high, for example, from storms or from shark attacks on cages. Moreover, some of the fish targeted for offshore production breed in ocean enclosures. And ocean fish cages, no matter how sturdy, are incapable of containing fish eggs. Another concern stems from the spread of pathogens and use of antibiotics and other drugs. Experience in both terrestrial and aquatic animal production demonstrates that concentration of large numbers of animals in a small area facilitates outbreaks of disease and parasites. Such pathogen outbreaks can jeopardize wild fish. They also lead producers to administer antibiotics and other drugs, usually via feed, to entire cages of fish so that the drugs inevitably end up in the marine environment. It is possible to significantly reduce drug use through vaccine development, as salmon farmers have accomplished to their credit, but these vaccines have not eliminated problems with pathogens and drug use. A third concern is water pollution. Raising large numbers of animals in small areas can result in pollution from fish wastes. In the case of fish pens or cages, these wastes flow directly into surrounding waters. In a scientific paper, I calculated that a $5 billion per year offshore aquaculture industry, a target figure used by NOAA, would discharge annually an amount of nitrogen equivalent to that in untreated sewage from 17 million people or the entire North Carolina hog industry of about 10 million hogs. In other words, although moving fish farms offshore should help dilute fish wastes, we cannot ignore the potential for water pollution. A fourth concern is farming of carnivores. Most of the species targeted for offshore production, such as halibut, cobia, and moi, like farmed salmon, are raised on feeds with high levels of fish meal and fish oil made from wild-caught fish. Unless new feed technologies are commercialized, farming fish offshore will likely require two to four times more wild fish to be caught for their feed than is ultimately harvested. Moreover, as noted by Senator Boxer, fish meal and oil can contain significant levels of chemicals such as PCBs. Without careful attention to the composition of fish feeds, offshore fish farming could produce relatively contaminated food products. Well, especially given the serious concerns about the impacts of offshore aquaculture development, it is critical that mandates to protect the marine environment and the public interest be incorporated in any offshore aquaculture legislation. One of the necessary mandates is environmental standards. To provide adequate protections for marine fisheries and ecosystems, no permit for offshore aquaculture should be issued unless the permit will not result in significant adverse impacts to marine fisheries and ecosystems. Unfortunately, S. 1195 lacks such mandates for environmental protection and instead gives NOAA enormous discretion to implement environmental standards. The bill thus appears to conflict with NOAA's own *Code of Conduct for Responsible Aquaculture Development,* which emphasizes such protections. Another key is public participation and access to information. A transparent public process helps to ensure that offshore aquaculture will not harm ocean resources important to stakeholders outside the aquaculture industry. Yet again, S. 1195 lacks any such provisions concerning transparency, public notice, and public comment periods for permit applications, and thus

again is in conflict with NOAA's own aquaculture code. A third element of legislation is managing ocean resources to minimize conflicts and maximize public benefits. Offshore aquaculture is one among many oceans uses that can affect the health and sustainability of ocean resources. Ideally, an offshore aquaculture system would operate within a broader regime that minimized conflicts and meet environmental and economic objectives for our oceans. Unfortunately, S. 1195 does not provide for such planning and governance, but rather establishes a national policy for aquaculture development without adequate balance of other interests. Well, in closing, NOAA's pursuit of offshore aquaculture development raises a number of concerns based on experience with other types of marine aquaculture. Offshore aquaculture should only go forward following implementation of strong environmental safeguards, and one of those which I didn't discuss would be the assessment of potential cumulative impacts of aquaculture development. Appropriate legal requirements must be established to ensure that projects meet strong environmental standards, are subject to public process, and are consistent with a larger framework for ocean governance. Thank you very much.

[The prepared statement of Dr. Goldburg follows:]

PREPARED STATEMENT OF REBECCA GOLDBURG, PH.D., SENIOR SCIENTIST, ENVIRONMENTAL DEFENSE

Introduction

I am honored to have the opportunity to testify today about the important issues surrounding offshore aquaculture. My name is Rebecca Goldburg. I am a biologist and Senior Scientist with Environmental Defense, a national nonprofit organization. Environmental Defense not only employs traditional advocacy tools, but also works with corporate partners such as FedEx, McDonald's, and CitiGroup. In a current partnership, Environmental Defense is working with Wegmans, a leading supermarket chain, to support producers of both wild and farmed seafood who are achieving high environmental standards.

I have co-authored a number of scientific articles concerning environmental impacts of aquaculture and was co-author of the Pew Oceans Commission's report on marine aquaculture. Among my current responsibilities, I serve as a member of the Marine Aquaculture Task Force, sponsored by the Woods Hole Oceanographic Institution and Pew Charitable Trusts, and the U.S. Department of Agriculture's Working Group to develop organic certification standards for aquaculture. I have an M.S. in Statistics, Ph.D. in Ecology, and honorary Doctorate of Laws, all from the University of Minnesota.

My testimony will focus on environmental concerns with offshore aquaculture development and the National Oceanic and Atmospheric Agency's (NOAA's) offshore aquaculture legislation, S. 1195. My testimony reflects my views and those of Environmental Defense, but not necessarily the task forces of which I am a member.

Aquaculture Is Essential to Expanding Future Seafood Supplies, but Can Also Diminish Them

Aquaculture is frequently cited as means to increase seafood supply in a world where greater quantities of fish cannot be obtained from the oceans. Without a doubt, our oceans are finite, and many fisheries are now overfished or heading toward depletion. At the same time, aquaculture is becoming an increasingly important source of seafood. Roughly 40 percent of all fish directly consumed by humans worldwide now originate from fish farms.

Environmental Defense supports aquaculture development as a means to increase seafood supplies; nevertheless, pursuing aquaculture development without adequate safeguards may be worse than not pursuing aquaculture at all. Although aquaculture and capture fishing are sometimes viewed as separate endeavors, the future of some aquaculture sectors is inextricably intertwined with fisheries and the health of marine ecosystems. While the production of channel catfish in freshwater ponds, tilapia in tanks, or crawfish in rice fields has little or no impact on marine fisheries,

some coastal forms of aquaculture, such as salmon farming in netpens or cages, or shrimp farming in saltwater ponds, typically degrade marine ecosystems and can result in a net loss of fish.[1]

Offshore Aquaculture Could Cause Significant Harm to Marine Ecosystems and Fisheries

Offshore aquaculture is patterned after salmon aquaculture, and can be expected to have similar (although not identical) impacts. Like farmed salmon, finfish raised offshore will be housed in net-cages. These are essentially animal feedlots which sit directly in marine waters, and are vulnerable to at least four distinct types of environmental problems.

1. *Escaped farmed fish:* Numerous studies[2] document the ecological damage caused by escaped farmed fish. Depending on the location, these include the introduction of nonnative fish species and reduced "fitness" of wild fish as a result of interbreeding with escapees of the same species. The offspring of crosses between escaped farmed with wild fish are a bit like pups from matings between domestic dogs and wolves—they are not as capable as surviving and reproducing in nature as their wild ancestors.

The likelihood of large-scale escapes from offshore farms is high if cages are sited in storm-prone areas such as the Gulf of Mexico. Even without storms, escapes frequently occur. In the Caribbean and Hawaii, sharks have torn open fish cages, letting fish escape. Moreover, unlike salmon which breed in freshwater, the marine species targeted for offshore production breed in marine waters. Atlantic cod, for example, breed in ocean enclosures, and although ocean fish cages are relatively sturdy, their very design renders them incapable of containing fish eggs.

The impacts of such fish escapes on the health of wild fisheries could be large if farmed fish are genetically less well-adapted to the ocean environment than local populations of wild fish. Farmed fish may be weaker genetically as a result of selective breeding, genetic engineering, or simply because fish being farmed were taken from a geographic area with different ecological conditions.

2. *Spread of pathogens and use of antibiotics and other drugs:* Experience in both terrestrial and aquatic animal production demonstrates that concentration of large numbers of animals in a small area almost inevitably facilitates outbreaks of disease and parasites. Such pathogen outbreaks can jeopardize wild fish. One recent study,[3] for example, shows that salmon farms in British Columbia spread parasitic sea lice from salmon farms to wild pink and chum salmon. It is reasonable to anticipate that similar situations will occur on offshore fish farms, especially if farms become large.

Disease and parasite outbreaks also lead producers to administer antibiotics and other drugs, usually via feed to entire cages of fish. These drugs inevitably end up in marine ecosystems, where they select for resistant bacteria, sometimes in types of wild fish consumed by humans.[4] In addition, their use results in foods from drug-treated animals—which many consumers prefer to avoid. It is possible to significantly reduce drug use through vaccine development, as salmon farmers have accomplished, to their credit. But, these vaccines have not eliminated problems with pathogens and drug use.

3. *Water pollution:* Modern "industrial" farms or feedlots—whether hog farms or fish farms—raise large numbers of animals in small areas, often using feeds imported from distant places. One common consequence is water pollution, as a significant fraction of the nutrients in feeds end up in the animals' wastes. In the case of fish pens or cages, there is no attempt to capture these wastes, which flow directly into surrounding waters.

In a scientific paper I published last year with Rosamund Naylor at Stanford University (copy included),[5] we estimated the potential impacts of waste discharges

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[1] Naylor, R., R.J. Goldburg, J. Primavera, N. Kautsky, M. Beveridge, J. Clay, C. Folke, H. Mooney, J. Lubchenco, and M. Troell. 2000. Effect of Aquaculture on World Fish Supplies. *Nature* 405: 1017–1024.

[2] Reviewed in Naylor, R., K. Hindar, I. Fleming, R. Goldburg, M. Mangel, S. Williams, J. Volpe, F. Whoriskey, J. Eagle, D. Kelso. 2005. Fugitive Salmon: Assessing Risks of Escaped Fish from Aquaculture. *BioScience* 55:427–437.

[3] Krosek, M., M.A. Lewis and J. Volpe. 2005. Transmission dynamics of parasitic sea lice from farm to wild salmon. Proc. Royal Society B. 272: 689–696.

[4] Ervik A., Thorsen B., Eriksen V., Lunestad B, Samuelsen O.B. 1994. Impact of administering antibacterial agents on wild fish and blue mussels *Mytilus edulis* in the vicinity of fish farms. *Diseases of Aquatic Organisms.* 18:45–51.

[5] Goldburg, R. and R. Naylor. 2005. Future seascapes, fishing, and fish farming. *Frontiers in Ecology and the Environment.* 3:21–28.

from a $5 billion U.S. aquaculture industry—a target figure used by NOAA. Using figures from salmon farming, we calculated that a $5 billion per year offshore aquaculture industry would discharge annually an amount of nitrogen equivalent to that in untreated sewage from 17.1 million people or the entire North Carolina hog industry of about 10 million hogs. Nitrogen is the nutrient primarily responsible for "eutrophication," including algal blooms and dead zones, in marine waters.

Of course, widely spaced marine fish farms sited in areas with strong currents would likely have little impact—an argument for moving marine fish farms out of the coastal zone and into marine waters. Nevertheless, fish farms may cluster geographically near infrastructure such as processing plants and transportation, just as terrestrial hog farms tend to do. If farms become large and clustered, or are sited in areas especially vulnerable to nutrient pollution, their water pollution impacts could be marked—just as water pollution has been a major impact of North Carolina's large, clustered hog farming industry.

4. *Farming carnivores:* Most of the species targeted for offshore production, such as halibut, cobia, and Pacific threadfin (moi), are—like farmed salmon—highly carnivorous. These fish are now raised on feeds with high levels of fish meal and fish oil made from wild caught fish. Until and unless new feed technologies are developed and commercialized, farming fish offshore will likely require two to four times more wild fish to be caught for their feed than is ultimately harvested.[6] The resulting net loss of fish protein means that offshore fish farming is *not* an alternative to capture fishing, and may actually *increase* fishing pressure on wild fish populations as demand and prices rise for fish meal and fish oil. Moreover, the current practice of capturing massive quantities of small fish such as sardines, anchovies, and mackerel to manufacture feed, may deprive marine predators, including many commercially important fish, of the food they need to flourish.

Farming carnivorous fish can also increase the amounts of environmental contaminants that consumers are exposed to in their food. Fish meal and oil can contain significant levels of chemicals such as PCBs. Several studies show that farmed salmon have higher concentrations of these contaminants in their flesh than most wild salmon. Without careful attention to the composition of fish feeds, offshore fish farming could not only increase pressure on wild fisheries but also produce relatively contaminated food products for U.S. consumers.

An Analysis of the Potential Cumulative Impacts of Offshore Aquaculture Development Is Essential

The environmental impacts of offshore aquaculture will depend, somewhat ironically, on the success of NOAA's push to develop offshore farms. Experimental or small-scale commercial fish farms, such as those now funded or subsidized by NOAA, are unlikely to have major environmental effects—as evidence to date confirms. But, what if offshore farming booms, and becomes a major means of food production, akin to the poultry or swine industries? What are the potential impacts on marine ecosystems and America's wild fisheries if NOAA policy "succeeds?"

A number of environmental, fishing, and consumer organizations, including Environmental Defense, have repeatedly asked NOAA over the last 18 months or so to draft a legislative environmental impact statement for S. 1195. However, the agency has not done so.

Nevertheless, an analysis of the potential cumulative impacts of offshore aquaculture is clearly essential if NOAA is to pursue offshore aquaculture in a careful and informed manner. Environmental Defense recommends that Congress require NOAA to complete such an assessment before legislation on offshore aquaculture is enacted.

NOAA's Offshore Aquaculture Legislation Lacks Provisions Essential To Safeguard Marine Fisheries and Ecosystems

Especially given the serious concerns about the impacts of offshore aquaculture development, it is critical that any pertinent legislation contain strong environmental safeguards. This case is argued persuasively by Stanford University scholar Rosamund Naylor in a Spring 2006 paper published in the National Academy of Sciences' journal "Issues in Science and Technology" (copy included).[7] Unfortunately, S. 1195 lacks key mandates essential to protecting the marine environment and the public interest, three of which are detailed below.

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[6] Naylor, R. and M. Burke. 2005. Aquaculture and ocean resources: Raising tigers of the sea. *Ann. Rev. Environ. Resour.* 30:1.1–1.34

[7] Naylor, R.L. 2006. Environmental safeguards for open-ocean aquaculture. *Issues in Science and Technology.* Spring issue: 53–58.

Mandatory environmental standards: To provide adequate protections for marine fisheries and ecosystems, no permit for offshore aquaculture should be issued unless the permit will not result in any significant adverse impacts to marine fisheries and ecosystems. Permits should be consistent with environmental standards that include provisions to minimize the ecological and genetic impacts of escaped farmed fish (for example by prohibiting farming of non-native fish); prevent the spread of disease and parasites by farmed fish; require monitoring for water pollution; strictly limit alteration of marine habitat; encourage the use of feeds with reduced levels of fisheries products; and bar harm to marine wildlife.

S. 1195 lacks such mandates for environmental protection, and instead gives NOAA enormous discretion to implement environmental standards the agency chooses to develop. S. 1195 thus appears to conflict with NOAA's own "*Code of Conduct for Responsible Aquaculture Development in the U.S. Exclusive Economic Zone,*" published in 2002, to provide guidance on marine aquaculture development. NOAA's Code stipulates that, "aquaculture development in the EEZ will adopt the guiding principle of a precautionary approach combined with adaptive management to achieve sustainable development in offshore waters." Moreover, the Code includes provisions intended to minimize disease, parasites, chemical inputs, and impacts on wild stocks, and to protect local communities.

Congress can also look to states for guidance. The State of California, which already bans the cultivation of salmon, non-native species and genetically-engineered organisms in marine fish farms, appears poised to enact legislation (S.B. 201) to mandate comprehensive environmental standards for farming of native fish species in the State's coastal waters. The California standards would address crucial issues, including selecting appropriate fish farm sites, preventing fish escapes, and minimizing use of fish-based feeds, drugs, and chemicals.

Public participation and access to information: A transparent public process helps to ensure that offshore aquaculture will not harm ocean resources important to stakeholders outside the aquaculture industry. Yet, S. 1195 lacks any provisions concerning transparency, public notice, and public comment periods for permit applications, nor do existing Department of Commerce regulations speak to these matters. Although S. 1195 mandates that NOAA "consult" with regional Fisheries Management Councils before issuing a permit, it is unclear what such consultation would entail. As a result, it is conceivable that NOAA's permit process could largely escape public scrutiny if an applicant declared the information in a permit application "confidential business information," or NOAA provided no public notice and comment period concerning the application.

This lack of transparency and public process is contrary to NOAA's 2002 "Code," which urges both transparency and public participation. The public should have access to information in permit applications needed to evaluate the environmental impacts of proposed facilities, and public notice and comment should be required.

Managing ocean resources to minimize conflicts and maximize public benefits: Offshore aquaculture is one among many oceans uses—such as energy production, conservation areas, and fishing—that affect the health and sustainability of ocean resources. A key conclusion of the U.S. Commission on Ocean Policy[8] is that while the Federal Government should manage ocean resources for the maximum long-term benefit of the Nation, current uncoordinated and incoherent offshore management undermines such management. A shift toward ecosystem-based management of offshore resources coupled with a strengthened governance system is necessary to better conserve and manage ocean resources. Decisions regarding the establishment of standards and approval processes for offshore aquaculture should take into account the need to establish an offshore management regime for all ocean resources and activities.

Ideally an offshore aquaculture system would operate within a broader offshore regime that minimized conflicts and meet environmental and economic objectives, including those of conservationists and fishermen. NOAA's 2002 *Code of Conduct for Responsible Aquaculture* urges that aquaculture zones be established to prevent conflicts and provide for efficient siting of facilities. Other areas might be off-limits because they are fishing grounds, shipping lanes, military sites, National Marine Sanctuaries, recreational areas, and so on. Unfortunately, S. 1195 does not provide for such planning and governance, but rather establishes a national policy for offshore aquaculture development without adequate balance of other economic and conservation interests.

S. 1195 also fails to require offshore aquaculture companies to pay back to the public a fair return for use of public trust resources. A key part of the government's commitment to maximizing the benefits to the Nation of public trust resources is

[8] U.S. Commission on Ocean Policy. 2004. *An Ocean Blueprint for the 21st Century*.

compensation—called resource rents—for their use by the private sector. The principle of returning a fair portion of funds to the public is applied on land to ranchers, timber and mining companies, and in the ocean to oil and gas companies. Environmental Defense recommends that resource rents from offshore aquaculture be required and that they are applied to activities that protect and restore the ocean environment.

Conclusion

NOAA's pursuit of offshore aquaculture development raises a number of concerns, based on experience with other types of marine aquaculture. These concerns are not purely environmental; degradation of marine ecosystems can harm fishermen's economic livelihoods, as well marine resources more broadly. Offshore aquaculture should only go forward following implementation of strong environmental safeguards, including assessment of potential cumulative impacts of aquaculture development. Appropriate legal requirements must be established to ensure that projects meet strong environmental standards, are subject to public process, and are consistent with a larger framework for ocean governance.

These requirements may seem stiff, but it is now widely recognized that our oceans are finite and vulnerable to abuse. Offshore aquaculture should only proceed under a framework that recognizes what we now know is necessary to protect and restore the health of our oceans and all of us who depend on them.

Thank you for your consideration.

The Ecological Society of America

FUTURE SEASCAPES, FISHING, AND FISH FARMING

by Rebecca Goldburg and Rosamond Naylor

The depletion of many marine fisheries has created a new impetus to expand seafood production through fish farming, or aquaculture. Marine aquaculture, especially of salmon and shrimp, has grown considerably in the past two decades, and aquaculturists are also beginning to farm other marine species. Production data for salmon and shrimp indicate that farming supplements, rather than substitutes for fishing. Since most farmed marine fish are carnivores, farming them relies on the capture of finite supplies of wild fish for use in fish feeds. As aquaculture is not substituting for wild fisheries, heavy dependence on wild fish inputs is a concern as marine aquaculture grows. Other likely impacts include escapes of farmed fish and large-scale waste discharges from fish farms. A viable future for marine ecosystems will require incorporation of ecological perspectives into polices that integrate fishing, aquaculture, and conservation. *Front Ecol Environ 2005; 3(1): 21–28.*

In a nutshell:

- Fish farming appears to be supplementing, not substituting for, capture fishing.
- The growth in marine fish farming may lead to increased competition for small fish, which serve as feed inputs for farmed fish and as prey for commercially valuable predatory wild fish.
- Farming of new marine species may lead to increased impacts from marine fish farming, including greater numbers of escaped farmed fish that interact with wild fish, and significant cumulative impacts from farm wastes.
- Policies governing marine ecosystems must incorporate ecological perspectives and integrate fishing, aquaculture, and conservation objectives.

People have long regarded the oceans as vast, inexhaustible sources of fish—a view reinforced by the copious catches of the past. Even when fish became scarcer or harder to catch, many people continued to assume that more fish were available (Kurlansky 1997). In the past decade or two, this view of fisheries has been transformed. Fisheries statistics suggest that annual global fish catches have plateaued at roughly 90 million metric tons (mt) per year (FAO 2002), or may even be declining (Watson and Pauly 2001). Global catch statistics present only part of the picture, however. Many fisheries are overfished or heading toward depletion (Hilborn *et al.* 2003). The mean trophic level of fish caught worldwide has declined substantially, in part because humans tend to consume larger, predaceous fish (Pauly *et al.* 2002; Hilborn *et al.* 2003). According to one estimate, commercial fishing has wiped out 90 percent of large fish, including swordfish, cod, marlin, and sharks (Myers and Worm 2003).

The oceans may now be poised for another transformation. Fisheries depletion has created new impetus to expand seafood production through fish farming, often known as aquaculture. Aquaculture is frequently cited as a way to increase seafood supply in a world where greater quantities of fish cannot be obtained from the oceans. It has become an increasingly important source of food; between 1992 and 2002, global production of farmed finfish and shellfish ("fish") almost tripled in weight and nearly doubled in value (FAO 2003). Currently, roughly 40 percent of all fish directly consumed by humans worldwide originate from commercial farms.

To date, most aquaculture production has been of freshwater fish, such as carp and tilapia, in Asia (Naylor *et al.* 2000; FAO 2003). However, marine aquaculture, particularly production of salmon and shrimp, has been growing rapidly. Salmon aquaculture originated in Norway in the 1970s, and has since boomed worldwide. Global production of farmed salmon roughly quadrupled in weight from 1992 to 2002, and farmed salmon now constitute 60 percent of fresh and frozen salmon sold in international markets (FAO 2003). This spectacular increase and the resulting decline in salmon prices (Naylor *et al.* 2003) have encouraged aquaculturists to begin farming numerous other marine finfish species, many of them now depleted by overfishing. New species being farmed include Atlantic cod (*Gadus morhua*), Atlantic halibut *(Hippoglossus hippoglossus*), Pacific threadfin (*Polydactylus sexfilis*), mutton snapper (*Lutjanus analis*), and bluefin tuna (*Thunnus* spp).

As with salmon, these new species are typically farmed in netpens or cages, anchored to the ocean bottom, often in coastal waters. In the U.S., where expansion of salmon farms in coastal waters has been met with local opposition and state-level restrictions, the U.S. National Oceanic and Atmospheric Administration (NOAA) is pursuing the development of large offshore aquaculture operations, primarily in the Exclusive Economic Zone (EEZ), away from coastal activities and beyond the reach of state laws (DOC 2004). In some areas, such as the Gulf of Mexico, there are plans to use offshore oil and gas rigs, some of which would otherwise have to be decommissioned, as platforms for new aquaculture facilities.

Taken together, these developments signal a new trend in marine fisheries production, away from capture of wild fish to human-controlled production. Supplementation of wild fish populations with hatchery-produced fish is also part of this trend, particularly since hatchery production of salmon set the stage for salmon farming.

Does this mean that production of farmed fish will supplant wild fisheries in the future? Aquaculture development is sometimes promoted as a means to relieve the pressure on wild fisheries. Some authors argue that capturing fish is akin to hunting terrestrial animals for food, an activity that has almost entirely been replaced by farming livestock (*e.g.,* Avery 1996). This comparison is imperfect, however, in part because fish tend to have much higher reproduction rates than warm-blooded land animals and therefore can generally sustain higher capture rates. Nevertheless, expanding production of farmed fish could lower prices and create economic conditions that, over time, will decrease investments in fishing.

Will fish farming supplant fishing?

Recent experiences in the salmon and shrimp sectors provide insights into the dynamics of farmed and wild production. The late 1980s marked a transition in global salmon markets. Quantities of both farmed stock and wild-caught fish jumped, causing total salmon output to increase from 776 thousand mt in 1988 to two million mt in 2001 (Figure 2). Farmed salmon production reached 1,217 thousand mt in 2002, 68 percent higher than the 722 thousand mt of wild-caught fish.

Over 90 percent of the farmed product is composed of Atlantic salmon (*Salmo salar*), a species that is nearly extinct in the wild. With a high degree of consumer substitution among salmon species, prices for all species have fallen as a result of increased market supplies. Between 1988 and 2002, the price of farmed Atlantic salmon fell by 61 percent and the price declines for North American Pacific salmon ranged from 54 percent for chinook (*Oncorhynchus tshawytscha*) to 92 percent for pink salmon (*Oncorhynchus gorbuscha*) (Naylor *et al.* 2003).

While global salmon catch has fluctuated between 720 thousand and 1 million mt since 1989—during a time when aquaculture was expanding—capture levels remain higher today than in the period leading up to 1990, when salmon farming was insignificant in global markets. It would therefore be premature to conclude that salmon farming is supplanting wild capture worldwide.

Moreover, "wild" salmon stocks are not entirely wild. Salmon capture has increased and salmon prices have fallen, in part because wild salmon populations have been supplemented by hatcheries. An estimated 4.4 billion salmon fry were released by hatcheries in Japan, the U.S., Russia, and Canada in 2001 (NPAFC 2004). Despite extremely low survival rates, hatchery fish currently account for one-third of the total salmon catch in Alaska (averaged across all species; ADFG 2004) and

virtually the entire chum catch of 211 thousand mt in Japan (FAO 2003; G. Knapp pers. comm.).

Farming of marine shrimp in coastal ponds boomed during the same period as salmon farming, but the dynamics between farmed shrimp and wild-caught shrimp differ from those seen in salmon. There is no hatchery supplementation of wild shrimp, and market demand for shrimp from the US, Europe, and Japan is seemingly limitless. Commercial farmed shrimp production began in the late 1970s, grew substantially in the 1980s, and reached 42 percent of total shrimp production by 2001 (Figure 3). At the same time, the quantities of wild-caught shrimp increased from 1.3 million mt in 1980 to about 1.8 million mt in 2001, and the total quantity of farmed and wild shrimp roughly doubled. Shrimp prices have generally fallen over this period; for example, prices for "26/30 count" frozen white shrimp (*Litopenaeus vannamei*) fell approximately 13 percent between 1990 and 2002 (H.M. Johnson pers. comm.). However, shrimp prices have been much more volatile than salmon prices (FAO 2003), in large part because outbreaks of various shrimp diseases have caused large country-specific fluctuations in shrimp numbers. Prices aside, the upward trend in shrimp capture indicates that aquaculture has not supplanted shrimp fishing globally.

There are signs that at least some types of marine aquaculture may be decreasing fishing activity in some regions, despite the lack of clear evidence that salmon and shrimp aquaculture are replacing fishing. Many Alaskan salmon fishermen have seen their incomes decline and some have quit fishing altogether (Naylor *et al.* 2003, in press). Declining incomes for shrimp fishermen in the southern U.S. have led the fishermen to press for anti-dumping tariffs against a number of major shrimp farming countries (Hedlund 2004). Over time, aquaculture may reduce the volume of wild-caught fish. However, economic inertia in the fishing industry, due to capital investments in fishing vessels, an inelastic labor force, and government subsidies, may mean that the fishing industry is slow to reduce capture rates in response to price declines (Naylor *et al.* 2000; Eagle *et al.* 2004).

Ecological Impacts of Fish Farming

The growth in marine aquaculture, and possibly also in hatchery production, will alter not just sources of marine fish and the economics of fishing, but may also transform the character of the oceans from relatively wild, or at least managed for fishing, to something more akin to agriculture. It is tempting to compare the future of the oceans to that of the North American prairie 150 years ago, which was mostly plowed under to grow crops. However, there are important differences. First, most marine fish farms will essentially be feedlots for carnivores, particularly if the salmon farming model is copied. Second, although fish farms are unlikely to occupy a large area, the ecological impact on marine resources could be much greater than the geographical extent of fish farms implies. This is because fish farming depends heavily on, and interacts with, wild fisheries.

Farming Carnivores

One obvious consequence of the proliferation of aquaculture is that more marine resources are required as inputs. Over the past two decades, roughly 30 million mt per year—close to one third of the current annual global fish catch—has been used for the production of fishmeal and fish oil for animal feeds. An increasing proportion of this catch is used in fish farming, as aquaculture production grows and the livestock and poultry sectors replace fishmeal with less expensive ingredients. In 2001, 17.7 million mt of marine and freshwater farmed fish were fed fishmeal containing ingredients derived from 17–20 million mt of wildcaught fish, such as anchovies, sardines, and capelin (Tacon 2003). Other farmed species, such as filter-feeding carp and mollusks, require no feeding.

Most farmed marine finfish are carnivores and are much more dependent on wild fisheries for the fishmeal and fish oil used in fish feeds than are farmed freshwater fish, which tend to be herbivores or omnivores (Naylor *et al.* 2000; Delgado *et al.* 2003). Fishmeal (at 38 percent) and oil (at 18 percent) are dominant components of salmon feeds (AGJ Tacon pers. comm.).

Continued growth in marine aquaculture production could outstrip the current supply of fish used for fishmeal and oil production, potentially jeopardizing the industry's economic sustainability (Naylor *et al.* 2000; Delgado *et al.* 2003). In early 2004, fishmeal prices rose to $650 per ton, the highest price since the 1997–1998 El Niño event and close to the record high (CRB 1998; FAO 2004). Moreover, this price seems to reflect a longer-term trend rather than the result of a sudden climatic event. Because feeds account for a large share of variable costs, aquaculturists raising carnivorous species are increasingly replacing fish-based products with

plant-based ingredients in fish feeds (Powell 2003), but not fast enough to reverse the trend in fishmeal use caused by rising aggregate production (Aldhous 2004).

Farming salmon and other carnivorous marine fish represents a net loss of fish protein, as about two to five times more wild-caught fish are used in feeds than are harvested from aquaculture (Naylor *et al.*, 2000; Weber 2003). Some aquaculturists argue that catching small, low trophic level fish to feed large, high trophic level farm fish is desirable, because this is more efficient than leaving small fish in the ocean to be consumed by wild predatory fish caught by fishermen (Hardy 2001). The relative efficiency of fish farming versus fishing is difficult to quantify, in part because energy transfer between trophic levels in marine systems is not well documented, and some farmed species, such as marine shrimp, feed at a higher trophic level than they would in the wild. Nevertheless, fish farming is probably more efficient than catching wild fish, because farmed fish are protected from some causes of mortality, especially predators.

Even if fish farming is comparatively efficient, its heavy dependence on wild fish inputs is both economically and ecologically problematic if aquaculture is supplementing, rather than substituting for, capture fisheries. Not only is the supply of these low trophic level fish finite, but the small fish used to make fishmeal and oil are critical food for wild marine predators, including many commercially valuable fish (Naylor *et al.* 2000).

Growth in aquaculture may shift fishing pressure from output fish such as salmon to the input species used in feeds (Delgado *et al.* 2003). Fisheries management has kept the total global catch of small fish for fishmeal and oil relatively constant in recent years. However, as demand for these commodities increases, rising prices could increase the incentives and therefore the political pressure to allow capture of a larger fraction of fish to produce meal and oil.

On the other hand, if marine aquaculture does begin to supplant capture fisheries, the impetus will shift from managing the oceans for fisheries production to managing them for aquaculture production. In this scenario, capturing low trophic level wild fish for aquaculture feeds, with little concern for the effect on higher trophic level wild fish, could form the basis for economically rational—although not ecologically sound—ocean management.

Stocking the Oceans

Another impact of the growth in marine aquaculture and supplementation of wild stocks stems from interactions between escaped farmed fish, hatchery fish, and wild fish. Escapes of farmed salmon from pens, both in episodic events and through chronic leakage, are well documented (Naylor *et al.* in review). The expansion of marine aquaculture and hatchery supplementation could substantially increase the numbers of introduced fish in marine waters.

Numerous studies have documented the ecological damage caused by escaped farm fish, especially among wild salmon, although some authors have found otherwise (Waknitz *et al.* 2003). Depending on the location, these may include the introduction of non-native fish species and reduced fitness of wild fish as a result of interbreeding with escapees of the same species (McGinnity *et al.* 2003; Naylor *et al.* 2004). Ocean "ranching" of hatchery fish, which are often genetically distinct from their wild counterparts, can cause similar problems (NRC 1996; Levin *et al.* 2001; Kolmes 2004). The impacts of fish escapes may not be recognized until they are irreversible (Naylor *et al.* 2004).

Most of the literature on the harmful effects of interbreeding between introduced and wild fish concerns salmon. These anadromous fish spawn in freshwater and will not reproduce in ocean pens. Other truly marine finfish, such as cod, do produce fertilized eggs in ocean enclosures (Bekkevold *et al.* 2002). Although cages used for offshore farming are more secure than salmon netpens, neither pens nor cages will prevent fish eggs from escaping. Farming at least some fish species might lead to "escapes" on a much larger scale than is seen in salmon.

One potentially mitigating factor is that populations of marine fish species may be less genetically differentiated than salmon, which have subpopulations adapted genetically to local conditions in river drainages. Salmon are therefore particularly prone to reduced fitness as a result of interbreeding with escaped, genetically distinct farmed and hatchery fish. Interbreeding may therefore have less genetic impact in truly marine fish species. All the same, some marine fish also have distinct subpopulations. Atlantic cod form aggregations that are genetically differentiated and there appears to be little gene flow between them (Ruzzante *et al.* 2001).

Both hatchery supplementation and escapes have the potential to supplant wild fisheries by reducing their fitness as well as their market share. Ironically, salmon aquaculture has provided the fishing industry with incentives to restructure and become more efficient (Eagle *et al.* 2004), yet part of the response to date has been

to release more hatchery fish, making up in volume what is lost in value. If aquaculture begins truly to replace capture fishing, however, the impetus for hatchery supplementation will be reduced. Meanwhile, escaped farmed fish and wild-farmed crosses are likely to become increasingly prevalent, unless new technology is developed that prevents the escape not only of adult fish but also of their gametes and embryos.

Nutrient Loading

Most marine aquaculture is modeled after terrestrial feedlots or "industrial" farms used to raise most hogs and poultry in the U.S. and elsewhere. Large numbers of animals are confined in a small area, and their feed imported, often from distant sources. Industrial animal facilities typically cluster geographically to benefit from economies of scale and favorable politics (L. Cahoon pers. comm.). One consequence is water pollution, since a substantial fraction of nutrients in animal feeds ends up in animal wastes, which often cannot all be assimilated by local croplands (Aneja *et al.* 2001; Gollehon *et al.* 2001; Mallin and Cahoon 2003). Water pollution from animal wastes is a major environmental issue in coastal North Carolina and other areas where animal production has concentrated.

Waste from finfish netpens and cages flows directly into marine waters and, in contrast to terrestrial farms, there is usually no attempt to capture it. Nutrients and suspended solids discharged by salmon farms can have considerable effects on a local scale (Goldburg *et al.* 2001), although salmon farms sited in well flushed areas often have minimal impact on the quality of surrounding waters (Brooks and Mahnken 2003). Dilution of nutrients means that widely spaced marine fish farms sited in areas with strong currents will probably have little impact, an argument for moving marine aquaculture out of coastal waters and into the open ocean (Marine Research Specialists 2003).

It is instructive to examine the potential cumulative impact of expanded marine aquaculture. NOAA's stated goal is the development of a $5 billion U.S. aquaculture industry by 2025. Using figures from salmon farming in British Columbia, we estimate how much nitrogen (N), the nutrient primarily responsible for eutrophication in marine waters, a $5 billion marine finfish aquaculture industry might discharge.

Producing a kilogram of salmon releases approximately 0.02 to 0.03 kg of N, excluding losses from uneaten feed (Brooks and Mahnken 2003). About 70,000 mt of salmon were produced in British Columbia in 2003 (C Matthews pers comm) with a gross domestic product value of C$91 million, or approximately US$66 million (Marshall 2003). Thus the BC salmon farming industry discharged about 1,435 mt to 2,100 mt of nitrogen. Extrapolating from these figures, a $5 billion would therefore discharge approximately 108,000 mt to 158,000 mt of nitrogen per year.

Americans excrete approximately 0.016 kg of N per day (Stipanuk 2000). Assuming conservatively that a $5 billion aquaculture sector discharges 100,000 mt of N per year, this discharge is equivalent to the amount of N in untreated sewage from approximately 17.1 million people for 1 year.

Every ton of hog waste contains about 12.3 lbs of N and a hog produces about 1.9 tons of waste per year (Shaffer 2004). Converting these numbers to metric figures, the North Carolina hog industry of 10 million hogs (USDA 2004) produces about 106,000 mt of N per year—roughly equivalent to the output from a $5 billion aquaculture industry.

Thus a $5 billion marine finfish aquaculture industry would discharge annually an amount of N equivalent to that in untreated sewage from 17.1 million people or the entire North Carolina hog industry of about 10 million hogs. On the other hand, a $5 billion offshore aquaculture industry would produce only about one tenth of 1 percent as much N as the 121 million mt annual biological nitrogen fixation in the world's oceans (Galloway 2003). On balance, therefore, the potential impacts of wastewater from marine aquaculture facilities are not cause for alarm, but should not be ignored, either, especially if such facilities are to be clustered geographically or sited in only moderately flushed areas.

Envisioning the Future

A viable future for marine ecosystems will almost certainly require integrating management for fisheries, fish farming, and conservation. Even if aquaculture begins to supplant wild fisheries, this process will probably be gradual, and fisheries will continue to be a major component of seafood production for some time.

Greatly improved fisheries management is essential (Pauly *et al.* 2002). Current management is based largely on single species models for which there is often inadequate data and which do not reflect interactions in marine ecosystems. Many scientists have called for a more risk-averse, ecosystem-based approach to fisheries management (NRC 1999; Dayton *et al.* 2002). As aquaculture grows, a more eco-

system-based approach will be critical in helping to balance the competing demands for low trophic level fish used either as feed or left in the oceans to support capture fisheries and conservation objectives. We are only just beginning to work out what an ecosystem-based approach to fisheries management should entail, so this is a topic that still requires extensive research (Pikitch *et al.* 2004).

Improving fisheries management is not solely a matter of better management science. Economic (and therefore political) factors also play a major role. Fisheries are generally a "commons" and fishermen lack a financial incentive to leave fish in the water for the future (NRC 1999). Steps that would alter this economic distortion include the removal of fishing subsidies (Milazzo 1998), the use of tools such as individual fishing quotas that create long-term fishing rights and incentives for fisheries conservation (Fujita *et al.* 1996), and the establishment of consumer and corporate purchase preferences for more sustainably produced seafood (Duchene 2004). Although economic, policy, and business research on these and related subjects is largely outside this paper's ecological focus, the success of new approaches will need to be validated by biologists as well as other experts.

Policy measures will also play a major role in marine aquaculture development. The Pew Oceans Commission (2003) called for a halt to the expansion of marine finfish farms until national standards and a comprehensive permitting authority are established for the siting, design, and operation of ecologically sustainable marine aquaculture facilities. Standards for environmentally sound marine finfish farming need to be defined, especially to implement NOAA's policies concerning offshore aquaculture development. Further research on the population genetics of marine fish species, related to the potential impacts of farmed fish escapes, is particularly important for setting standards. Innovative approaches to fish farming, as well as a better understanding of the potential cumulative impacts of large-scale ocean farming, could help marine aquaculture to become more environmentally sustainable.

The industry is already addressing some important issues, driven at least partly by financial considerations. Feed is a major cost, and potential future increases in the price of fishmeal and fish oil could make it a larger one. There has already been a substantial reduction in the fishmeal and oil content of aquaculture feeds, and increased efficiency of feed use, particularly for salmonids (A.G.J. Tacon per. comm.).

Identifying lower trophic level marine finfish suitable for farming may be another step toward more sustainable aquaculture. Integrated systems, in which mussels, seaweeds, and other species are grown in close proximity with finfish to recycle wastes, shows great promise (Neori *et al.* 2004), but a greater understanding of the interactions and processes that take place among jointly cultured species, as well as larger scale experimentation, are necessary to help make integrated marine aquaculture commercially viable (Troell *et al.* 2003). Market research on products from integrated systems is also needed, particularly if chemicals or pharmaceuticals are used in the finfish netpens.

One recent, comprehensive analysis (Delgado *et al.* 2003) identifies fish, fishmeal, and fish oil as commodities almost certain to increase in price by the year 2020, while prices for commodities such as beef, eggs, and vegetable meals are likely to come down. Rising prices for fish will probably cause further exploitation of the oceans for fishing and aquaculture, and make competition for marine resources more intense. Protecting ocean resources may require deliberative processes to partition them—for example, designating certain areas of the ocean for certain uses or for non-use. The development of marine protected areas where fishing and other activities are not permitted is under active testing as a tool for both conservation and fisheries management (Lubchenco *et al.* 2003), but there has been little systematic investigation of possibilities for demarcating the ocean in other ways (*e.g.,* temporally) or for other purposes (*e.g.,* aquaculture).

The future prospects for ocean fisheries appear grim, given current trends in fish production. Many capture fisheries are declining, and marine aquaculture—the alleged escape valve for fisheries—offers its own challenges, including a heavy dependence on robust fisheries resources. Establishing viable, long-term solutions to problems in fisheries and marine aquaculture will require the incorporation of ecological perspectives into the policies governing fisheries management, aquaculture systems, and the rationalization of ocean resources.

Acknowledgements

We thank M. Burke, S. Lamster, L. Jantzen, and B. Goodman for comments and assistance, and the David and Lucile Packard Foundation for funding.

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Courtesy of The David Suzuki Foundation

Figure 1. *A salmon farm in British Columbia.*

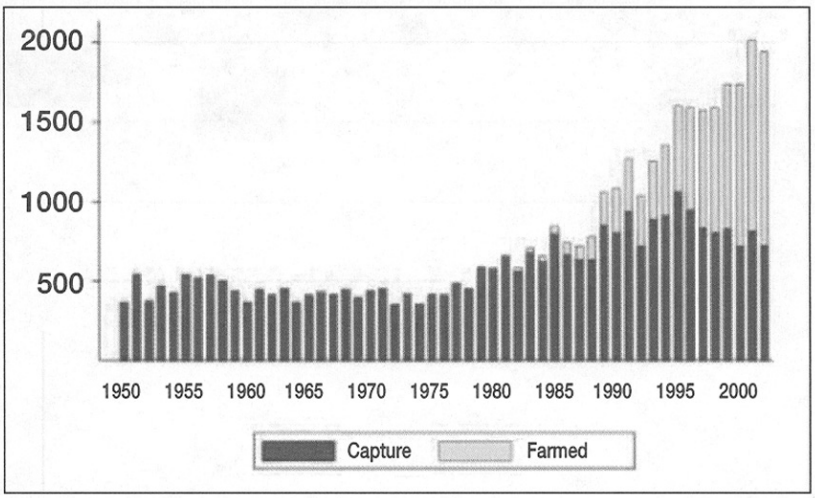


Figure 2. *Global farmed and capture production of salmon, 1950–2002. Data in thousands of metric tons. From FAO (2003).*

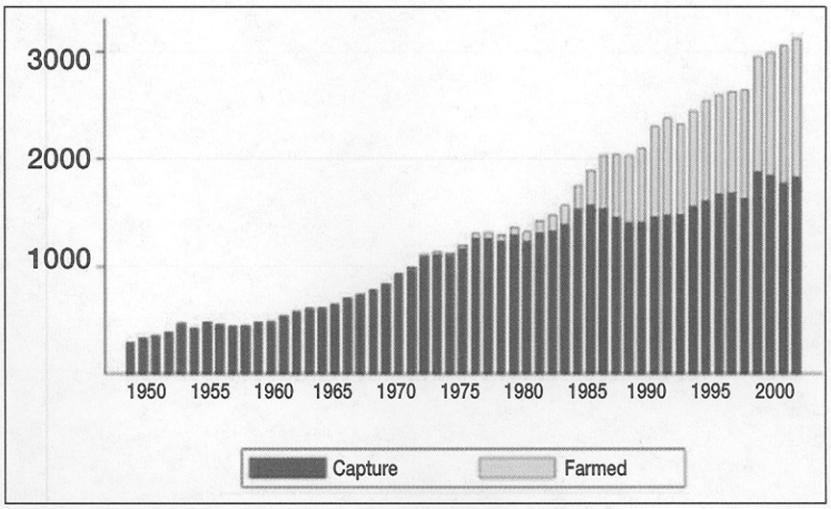
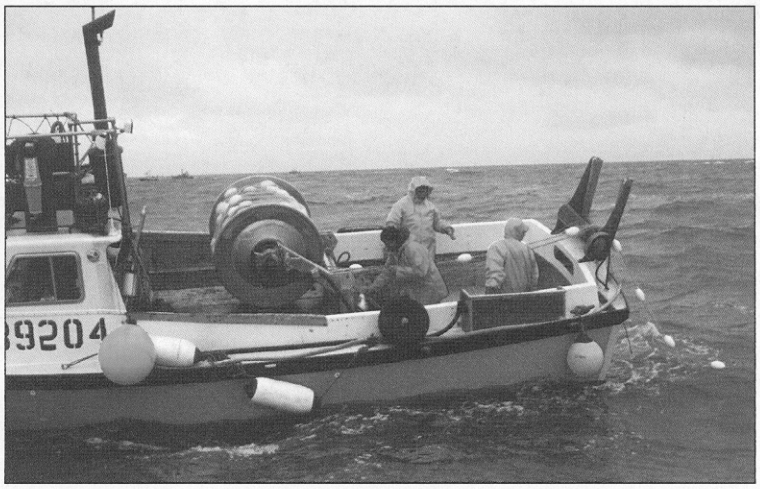


Figure 3. *Global farmed and capture production of shrimp, 1950–2002. Data in thousands of metric tons. From FAO (2003).*



Courtesy of the NOAA

Figure 4. *Gillnetter* F/V Helen Marg *putting out nets for salmon in Bristol Bay, Alaska.*

Courtesy of the US Fish and Wildlife Service

Figure 5. *Wild Atlantic salmon.*

Courtesy of the NOAA

Figure 6. *View from inside a Hawaii offshore aquaculture cage containing Pacific threadfin* (moi).

Issues in Science and Technology, Spring 2006

Environmental Safeguards for Open-Ocean Aquaculture

Expanding aquaculture into federal waters should not be promoted without enforceable national guidelines for the protection of marine ecosystems and fisheries

by Rosamond L. Naylor

Because of continued human pressure on ocean fisheries and ecosystems, aquaculture has become one of the most promising avenues for increasing marine fish production. During the past decade, worldwide aquaculture production of salmon, shrimp, tuna, cod, and other marine species has grown by 10 percent annually; its

value, by 7 percent annually. These rates will likely persist and even rise in the coming decades because of advances in aquaculture technology and an increasing demand for fish and shellfish. Although aquaculture has the potential to relieve pressure on ocean fisheries, it can also threaten marine ecosystems and wild fish populations through the introduction of exotic species and pathogens, effluent discharge, the use of wild fish to feed farmed fish, and habitat destruction. If the aquaculture industry does not shift to a sustainable path soon, the environmental damage produced by intensive crop and livestock production on land could be repeated in fish farming at sea.

In the United States, aquaculture growth for marine fish and shellfish has been below the world average, rising annually by 4 percent in volume and 1 percent in value. The main species farmed in the marine environment are Atlantic salmon, shrimp, oysters, and hard clams; together they account for about one-quarter of total U.S. aquaculture production. Freshwater species, such as catfish, account for the majority of U.S. aquaculture output.

The technology is in place for marine aquaculture development in the United States, but growth remains curtailed by the lack of unpolluted sites for shellfish production, competing uses of coastal waters, environmental concerns, and low market prices for some major commodities such as Atlantic salmon. Meanwhile, the demand for marine fish and shellfish continues to rise more rapidly than domestic production, adding to an increasing U.S. seafood deficit (now about $8 billion annually).

The U.S. Department of Commerce has articulated the need to reverse the seafood deficit, and under the leadership of its subagency, the National Oceanic and Atmospheric Administration (NOAA), has a stated goal of increasing the value of the U.S. aquaculture industry from about $1 billion per year currently to $5 billion by 2025. In order to achieve this goal, the Department of Commerce has set its sights on the Federal waters of the Exclusive Economic Zone (EEZ), located between the 3-mile state zone and 200 miles offshore, where the potential for aquaculture development appears almost limitless. The United States has the largest EEZ in the world, amounting to 4.5 million square miles, or roughly 1.5 times the landmass of the lower 48 states. Opening Federal waters to aquaculture development could result in substantial commercial benefits, but it also poses significant ecological risks to the ocean—a place many U.S. citizens consider to be the Nation's last frontier.

On June 8, 2005, Commerce Committee Co-Chairmen Sens. Ted Stevens (R–AK) and Daniel Inouye (D–HI) introduced the National Offshore Aquaculture Act of 2005 (S. 1195). The bill, crafted by NOAA, seeks to support offshore aquaculture development within the Federal waters of the EEZ; to establish a permitting process that encourages private investment in aquaculture operations, demonstrations, and research; and to promote R&D in marine aquaculture science and technology and related social, economic, legal, and environmental management disciplines. It provides the secretary of Commerce with the authority and broad discretion to open Federal waters to aquaculture development, in consultation with other relevant Federal agencies but without firm environmental mandates apart from existing laws. The bill's proponents argue that fish farming in the open ocean will relieve environmental stress near shore and protect wild fisheries by offering an alternative means of meeting the rising demand for seafood. However, because it lacks a clear legal standard for environmental and resource protection, the bill's enactment would likely lead to a further decline in marine fisheries and ecosystems.

The introduction of S. 1195 came as no surprise to the community of environmental scientists and policy analysts who have followed the development of aquaculture in the United States. In 1980, Congress passed the National Aquaculture Act to promote aquaculture growth, and in the process established the Joint Subcommittee on Aquaculture, an interagency body whose task was to provide coordination and seek ways to reduce regulatory constraints on aquaculture development. Despite these actions, local concerns and associated regulatory burdens have limited the expansion of marine aquaculture within the 3-mile jurisdiction of many states, and regulatory uncertainty has discouraged investment in offshore production between the 3-mile state zone and the 200-mile EEZ. The Bush administration is now prepared to support efforts to streamline regulatory authority within the Federal waters of the EEZ, promote open-ocean aquaculture, and make the United States a more competitive producer of marine-farmed fish.

Implementing S. 1195 would involve a two-tiered process: first, the creation of a law authorizing the leasing and permitting of open-ocean aquaculture facilities by the secretary of Commerce; and second, the start of rulemaking procedures within and among Federal agencies. If passed, the bill would allow NOAA to issue site and operating permits within Federal waters with 10-year leases, renewable for 5-year periods. Decisions on permit applications would be granted within 120 days and would not require a lengthy inventory process to assess the state of marine re-

sources at each site. The proposed legislation requires NOAA to "consider" environmental, resource, and other impacts of proposed offshore facilities before issuing permits; however, there is no requirement that NOAA actually identify and address those impacts before the permits and leases are granted. Similarly, the bill does not require that, during the permitting process, NOAA weigh the risks to the marine environment against the commercial benefits of aquaculture development.

The pro-fish-farming language of S. 1195, without commensurate language on the conservation of ocean resources and ecosystems, is extremely worrisome. It is unlikely that ocean resources will be protected in the face of aquaculture development unless the statute requires specific language on environmental mandates—not just "considerations"—for the rulemaking and permitting processes.

Open-ocean aquaculture encompasses a variety of species and infrastructure designs; in the United States, submersible cages are the model used for offshore finfish production. These cages are anchored to the ocean floor but can be moved within the water column; they are tethered to buoys that contain an equipment room and feeding mechanism; and they can be large enough to hold hundreds of thousands of fish in a single cage. Robotics are often used for cage maintenance, inspection, cleaning, and monitoring. Submersible cages have the advantage of avoiding rough water at the surface and reducing interference with navigation. A major disadvantage of offshore operations is that they tend to be expensive to install and operate. They require sturdier infrastructure than near-shore systems, they are more difficult to access, and the labor costs are typically higher than for coastal systems.

The economic requirements of open-ocean aquaculture suggest that firms are likely to target lucrative species for large-scale development or niche markets. In the United States, moi is produced commercially far from shore in Hawaii state waters, and experiments are being conducted with halibut, haddock, cod, flounder, amberjack, red drum, snapper, pompano, and cobia in other parts of the country. Tuna is another likely candidate for offshore development. Altogether, about 500 tons of fish are currently produced each year in submersible cages in the United States, primarily within a few miles of shore. The technology appears to have real promise, even though it is not yet economically viable for commercial use in most locations, and it is not yet deployed widely in Federal waters far from shore.

Some of the species now farmed in open-ocean cages, such as bluefin tuna, Atlantic cod, and Atlantic halibut, are becoming increasingly depleted in the wild. Proponents of offshore aquaculture often claim that the expansion of farming into Federal waters far from shore will help protect or even revive wild populations. However, there are serious ecological risks associated with farming fish in marine waters that could make this claim untenable. The ecological effects of marine aquaculture have been well documented, particularly for near-shore systems, and are summarized in the 2005 volumes of the *Annual Review of Environment and Resources, Frontiers in Ecology* (February), and *BioScience* (May). They include the escape of farmed fish from ocean cages, which can have detrimental effects on wild fish populations through competition and interbreeding; the spread of parasites and diseases between wild and farmed fish; nutrient and chemical effluent discharge from farms, which pollutes the marine environment; and the use of wild pelagic fish for feeds, which can diminish or deplete the low end of the marine food web in certain locations.

Because offshore aquaculture is still largely in the experimental phase, its ecological effects have not been widely documented, yet the potential risks are clear. The most obvious ecological risk of offshore aquaculture results from its use of wild fish in feeds, because most of the species being raised in open-ocean systems are carnivorous. If offshore aquaculture continues to focus on the production of species that require substantial quantities of wild fish for feed—a likely scenario because many carnivorous fish command high market prices—the food web effects on ecosystems that are vastly separated in space could be significant.

In addition, although producers have an incentive to use escape-proof cages, escapes are nonetheless likely to occur as the offshore industry develops commercially. The risks of large-scale escapes are high if cages are located in areas, such as the Gulf of Mexico, that are prone to severe storms capable of destroying oil rigs and other sizable marine structures. Even without storms, escapes frequently occur. In offshore fish cages in the Bahamas and Hawaii, sharks have torn open cages, letting many fish escape. In addition, farming certain species can lead to large-scale "escapes" from fertilization. For example, cod produce fertilized eggs in ocean enclosures, and although ocean cages are more secure than near-shore net pens, neither pens nor cages will contain fish eggs. The effects of such events on native species could be large, regardless of whether the farmed fish are within or outside of their native range. At least two of the candidate species in the Gulf of Mexico (red drum

and red snapper), as well as cod in the North Atlantic, have distinct subpopulations. Escapes of these farmed fish could therefore lead to genetic dilution of wild populations, as wild and farmed fish interbreed.

Offshore aquaculture also poses a risk of pathogen and parasite transmission, although there is currently little evidence for disease problems in offshore cages. In general, however, large-scale intensive aquaculture provides opportunities for the emergence of an expanding array of diseases. It removes fish from their natural environment, exposes them to pathogens that they may not naturally encounter, imposes stresses that compromise their ability to resist infection, and provides ideal conditions for the rapid transmission of infectious agents. In addition, the production of high-valued fish often involves trade in live aquatic animals for bait, brood stock, milt, and other breeding and production purposes, which inevitably results in transboundary spread of disease. The implications of open-ocean farming for pathogen transmission between farmed and wild organisms thus remains a large and unanswered question. Moreover, pathogen transmission in the oceans is likely to shift in unpredictable ways in response to other human influences, particularly climate change.

Even the claim that open-ocean aquaculture provides "a dilution solution" to effluent discharge may be disputed as the scale of aquaculture operations expands to meet economic profitability criteria. The ability of offshore aquaculture to reduce nutrient pollution and benthic effects will depend on flushing rates and patterns, the depth of cage submersion, the scale and intensity of the farming operations, and the feed efficiency for species under cultivation. Scientific results from an experimental offshore system in New Hampshire indicate no sedimentation or other benthic effects, even when the cages are stocked with more than 30,000 fish. However, commercial farms will likely have 10 or more times this density in order to be economically viable; commercial salmon farms commonly stock 500,000 to a million fish at a site. It is not a stretch to imagine a pattern similar to that of the U.S. industrial livestock sector, with large animal operations concentrated near processing facilities and transportation infrastructure, and in states with more lenient environmental standards.

An essential question in the debate thus remains: What is the vision of the Department of Commerce in developing offshore aquaculture? If the vision is to expand offshore production to a scale sufficient to eliminate the $8 billion seafood deficit, the ecological risks will be extremely high.

In 2003 and 2004, the U.S. Commission on Ocean Policy and the Pew Oceans Commission completed their reports on the state of the oceans and suggested various policy reforms. Both reports acknowledged the rising role of aquaculture in world markets, described its effects on ocean ecosystems, and recommended NOAA as the lead Federal agency to oversee marine aquaculture in the United States. The main difference between the reports is captured in the recommendations. Whereas the U.S. Commission recommended that the United States pursue offshore aquaculture, acknowledging the need for environmentally sustainable development, the Pew Commission recommended a moratorium on the establishment of new marine farms until comprehensive national environmental standards and policy are established. The drafting of S. 1195 clearly follows the U.S. Commission approach but uses even weaker environmental language, which allows for multiple interpretations and no clear mandate on marine resource and ecosystem protection.

The main problem with the proposed legislation is the broad discretion given to the secretary of Commerce to promote offshore aquaculture without clear legal standards for environmental protection. The authority is intended to facilitate a streamlining of regulations, yet it provides minimal checks and balances within the system. The bill states that the secretary "shall consult as appropriate with other Federal agencies, the coastal states, and regional fishery councils . . . to identify the environmental requirements applicable to offshore aquaculture under existing laws and regulations."An implicit assumption of the bill is that most of the needed environmental safeguards are already in place. Additional environmental regulations targeted specifically for offshore aquaculture are to be established in the future "as deemed necessary or prudent by the secretary" in consultation with other groups. Yet timing is everything. If the law is passed without the establishment of comprehensive national guidelines for the protection of marine species and the environment—and the requirement that these guidelines be implemented—such protection may never happen, or it may happen after irreversible damages have occurred.

Are current Federal laws sufficient to protect the environment in the EEZ? The answer is no. As a framework, they leave major gaps in environmental protection. The Rivers and Harbors Act gives the Army Corps of Engineers the authority to issue permits for any obstruction in Federal waters (including fish cages) but does not provide clear environmental mandates. The Corps has the broad discretion to

ensure environmental quality but is not required to do so. The Outer Continental Shelf Lands Act extends this authority farther offshore beyond the territorial waters of the EEZ and applies to any offshore facilities that are anchored on or up to 1 mile from offshore oil rigs; in this case, further permit approval is required from the Department of Interior. The Clean Water Act gives the Environmental Protection Agency (EPA) the authority to regulate waste discharges from aquaculture facilities, but the agency's recent effluent guidelines for aquaculture net pens, which presumably would be applied to offshore cages, focus simply on the use of best management practices. Aquaculture discharge is not currently regulated through the National Pollution Discharge Elimination System (NPDES), the permitting system used for municipal and industrial point-source discharge to U.S. waters. The Endangered Species Act and the Marine Mammal Protection Act both are applicable in the EEZ and can be used to limit offshore aquaculture operations if they are proven to threaten any listed threatened or endangered species, or if they unlawfully kill marine mammals. In addition, the Lacey Act gives the U.S. Fish and Wildlife Service the authority to regulate the introduction of exotic species in Federal waters if they have been listed specifically as "injurious" to other species. The Lacey Act applies to any species that are transported or traded across borders, but not to species that already exist within borders. Finally, all international treaties and protocols would apply to offshore aquaculture in the EEZ.

The only Federal law that the proposed bill would explicitly supersede is the Magnuson-Stevens Act (MSA) of 1976, which stipulates a balance between fishing and conservation. S. 1195 does not include any specific balancing requirements between ecosystems and industry. Regional fishery management councils established under the MSA as well as the public would be consulted in the process of environmental rulemaking but would not have a determining effect on the outcome.

Although S. 1195 supersedes only one Federal law, existing legislation does not adequately address the major risks of farmed fish escapes and genetic dilution of wild stocks, pathogen transmission from farms to wild organisms, and cumulative effluent discharge. Most existing laws and regulations for marine aquaculture are found at the state level, where current near-shore systems operate. Few states have comprehensive regulatory plans for marine aquaculture, and there are no regional plans that address the risks of biological, chemical, or nutrient pollution that spreads from one coastal state to the next.

The proposed bill gives coastal states an important role in influencing the future development of offshore aquaculture. Indeed, coastal states would be permitted to opt out of offshore aquaculture activities. The bill states that offshore aquaculture permits will not be granted or will be terminated within 30 days if the secretary of Commerce receives written notice from the Governor of a coastal state that the state does not wish to have the provisions of the act apply to its seaward portion of the EEZ. The Governor can revoke the opt-out provision at any time, thus reinstating NOAA's authority to issue permits and oversee aquaculture operations in that portion of the EEZ. Although the bill does not grant coastal states any jurisdiction over that part of the EEZ, it does provide them with potential exclusion from offshore aquaculture activities.

This amendment ensures a role for coastal states that is stronger than that which would apply through the Consistency Provision (section 307) of the Coastal Zone Management Act (CZMA). Section 307 of the CZMA requires that federally permitted projects be consistent with select state laws that safeguard coastal ecosystems, fisheries, and people dependent on those fisheries (collectively called the state's "coastal zone management program"). To complete the permitting process for an offshore aquaculture project, the project applicant must certify the project's consistency with the state's coastal zone management program to NOAA. Even if the state objects to the applicant's consistency certification, the secretary of Commerce can override the state's objection and issue the permit simply by determining that the project is consistent with the objectives or purposes of the Federal Coastal Management Act or that the project is necessary in the interest of national security. Thus, the Department of Commerce retains ultimate authority over whether state laws apply to the EEZ.

Although the decision by different coastal states to opt out of the proposed offshore aquaculture bill is yet to be determined, some states have already adopted policies related to aquaculture development within state waters. In Alaska, state law prohibits finfish farming within the 3-mile state zone. In Washington, House Bill 1499 allows the Washington Department of Fish and Wildlife to have more control over environmental damages caused by near-shore salmon farming. In California, salmon farming and the use of genetically modified fish are prohibited by law in marine waters, and a new bill currently being reviewed in the state assembly (SB. 210) requires strict environmental standards for all other forms of marine

aquaculture introduced into state waters. The California legislation, in particular, provides an excellent model for a redrafting of the National Offshore Aquaculture Act.

The Need for National Environmental Standards

Whether environmentalists like it or not, marine aquaculture is here to stay and will inevitably expand into new environments as global population and incomes grow. Although the United States is in a position to make itself a global model for sustainable fish production in the open ocean, the proposed bill unfortunately falls far short of this vision. Pursuant to the recommendations of the Pew Commission, an aggressive marine aquaculture policy is needed at the national level to protect ocean resources and ecosystems. Within this policy framework, several specific features are needed:

- The establishment of national environmental standards for siting and operation that minimize adverse effects on marine resources and ecosystems and that set clear limits on allowable ecological damage.
- The establishment of national effluent guidelines through the EPA for biological, nutrient, and chemical pollution from coastal and offshore fish farms, using NPDES permits to minimize cumulative effluent impacts.
- The establishment of substantive liability criteria for firms violating environmental standards, including liability for escaped fish and poorly controlled pathogen outbreaks.
- The establishment of rules for identifying escaped farm fish by their source and prohibiting the use of genetically modified fish in ocean cages.
- The establishment of a transparent process that provides meaningful public participation in decisions on leasing and permitting of offshore aquaculture facilities and by which marine aquaculture operations can be monitored and potentially closed if violations occur.
- The establishment of royalty payments process for offshore aquaculture leases that would compensate society for the use of public Federal waters.

At the same time, firms exceeding the minimum standards should be rewarded, for example, through tax breaks or reductions in royalty fees, in order to encourage environmental entrepreneurship and international leadership. By articulating a comprehensive set of environmental standards and incentives within the draft of the law, the bill would gain acceptance by a broad constituency interested in the sustainable use of ocean resources.

Proponents of offshore aquaculture might argue that these recommendations hold the industry to exceedingly high standards. Yes, the standards are high, but also essential. There is now a widespread realization that the ability of the oceans to supply fish, assimilate pollution, and maintain ecosystem integrity is constrained by the proliferation of human activities on land and at sea. Offshore aquaculture could help to alleviate these constraints, but only if it develops under clear and enforceable environmental mandates.

Senator SUNUNU. Thank you, Doctor. Mr. Belle, welcome.

STATEMENT OF SEBASTIAN BELLE, EXECUTIVE DIRECTOR, MAINE AQUACULTURE ASSOCIATION

Mr. BELLE. Thank you very much, Mr. Chairman, members of the Subcommittee, and a particular thanks to Senator Snowe for all her hard work. Her constituents appreciate it, and we know you have worked hard down here. My name is Sebastian Belle. I am the Executive Director of the Maine Aquaculture Association. The Maine Aquaculture Association is the oldest state aquaculture association in the country. We represent finfish and shellfish growers that grow fish and shellfish in both fresh and saltwater. Based on farm gate value sales, we have about an $80 million industry on an average year in the State of Maine. We have been operating for over 20 years. The first farm went in 30 years ago in Maine, and I would like to say a couple things before I start. The challenges that have been identified by the previous witnesses are fair and

real. The concerns are fair and real. Solutions are possible, and I would encourage you to look to Maine and our experience there in terms of how we have balanced these concerns and the ability to have a sustainable development over the last 20 years. I think we have learned a lot. We have made some mistakes. But the solutions are out there, and the problems are not insurmountable. I'm going to make two general comments, and then I would like to focus on a couple of the specifics of the bill. If we don't do it, somebody else will, and I think the case of Alaska is a great example. Although Alaska moved early to prohibit salmon farming, farmed salmon supplies now exceed wild catches worldwide. Salmon farming has developed rapidly in other countries irrespective of Alaska's prohibition on salmon farming. This has happened because aquaculture development worldwide is being driven by strong fundamental economic trends. If somebody else does it, environmental risks will be larger, not smaller, and I have firsthand experience in that. I have worked in many other countries around the world where aquaculture is growing much more rapidly than in the United States. Many of those countries have little or no environmental restrictions, and we are eating the seafood coming from those countries in this country. If we do not allow a competitive domestic aquaculture industry to develop in this country, we will in part be contributing to environmental impacts in other places in the world, and I think we need to understand that and be prepared to accept responsibility for that. Finally, I'd like to say that balanced development between commercial fisheries and aquaculture is achievable. We have done it for 20 years in Maine. If we can do it in nearshore locations in Maine with significant commercial fisheries, diverse and healthy marine ecosystems, extensive recreational use and commercial shipping, it can be done in the EEZ. It takes time, patience, hard work, and agency resources, but it can and has been done successfully. Whether aquaculture products are produced in the U.S. or overseas has little to do with whether these products will compete with wild products. As highlighted in my previous points, the United States has a choice. We can either allow the development of domestic aquaculture, help it compete with overseas producers, and ensure a balance between commercial fishing and aquaculture interests. Conversely, we can prohibit domestic aquaculture and force our domestic commercial fisheries to compete directly with low-cost, unregulated overseas aquaculture producers. A couple of specific points on the bill—the site permits, and I think Mr. Cates alluded to this, the site permits are initially issued for 10 years and then renewed for 5 years. From the private sector's point of view, the investment and time involved in developing an offshore operation is extensive. There is a lot of money involved. A 10-year time horizon is too short. Very few investors are going to invest if their leasehold is only for 10 years. It's particularly concerning that the 5-year renewal period is shorter than the initial period. You would assume that if somebody was out there and had been operating for a period of 10 years, that they would have a track record, and that, in fact, the renewal would be for a longer period, not a shorter period. During the permit review process, S. 1195 requires the Secretary to consult with other Federal agencies. S. 1195 further requires that the Secretary renders a permit deci-

sion within 120 days of the application being deemed complete. S. 1195 contains no requirement for the timely reply by other Federal agencies to the Secretary's request for consultation and review. S. 1195 should establish a time shorter than 120 days within which other Federal agencies must reply to the Secretary. This requirement should include a provision that clarifies that a lack of reply within that time period constitutes agreement by other Federal agencies to the permit's issuance. If regional fisheries management councils are consulted, this provision should apply to them as well. My final comment is on the State opt-out. I have worked for a period of my career for a state agency, and I have a great deal of respect for state's rights and the ability for states to determine their own future. Having said that, the amendment 769, as it's written now, my interpretation is that it would significantly reduce investor confidence and decrease the likelihood of investment due to its impact on the security of their investment. Any aquaculture operation that has gone through all the permitting processes and is being operated responsibly and in good faith could have its license to do business revoked without cause with 30 days notice. No investor is likely to move forward with a project with that level of uncertainty and risk. If a State wants to opt-out as a matter of policy prior to the initiation of any permit applications, it should have the right to do that as that opt-out will have direct impacts on the economic potential of Federal waters that all U.S. citizens have an interest in. That State should be required to justify the grounds for the opt-out and document the economic impacts of the opt-out on the national economy. Thank you very much for your time.

[The prepared statement of Mr. Belle follows:]

PREPARED STATEMENT OF SEBASTIAN BELLE, EXECUTIVE DIRECTOR, MAINE AQUACULTURE ASSOCIATION

Senator Stevens, Senator Sununu, Honorable Members of the U.S. Senate Committee on Commerce, Science, and Transportation, Subcommittee on National Ocean Policy Study:

Thank you for providing me the opportunity to speak with you today. My name is Sebastian Belle and I am the Executive Director of the Maine Aquaculture Association (MAA). The MAA is the oldest state aquaculture association in the country. We represent aquatic farmers who grow both shellfish and finfish in salt and freshwater farms. We also represent the many infrastructure companies that provide goods and services to our producers. Based on farm gate sales, Maine has been the number one marine aquaculture state for 10 of the last 15 years. On an average year, our members grow products worth over $80 million at the farm gate.

I stand before you today to testify in support of S. 1195, "The National Offshore Aquaculture Act of 2005". S. 1195 establishes a framework through which the Department of Commerce can oversee the development of aquaculture in Federal waters referred to hereafter as the EEZ.

I would like to begin my testimony with some general comments and then respectfully suggest a few specific modifications that would be constructive from the private sector's perspective. I will start with a disclaimer. MAA has a diverse membership that ranges from mom-and-pop owner operated farms to larger corporately-owned farms. My comments today are my own and are based on my experience of 30 years in commercial fishing and aquaculture. Given our diverse membership, any number of my members may submit comments directly. I would encourage the Committee to carefully review those comments as well.

General Comments

1. If We Don't Do it Someone Else Will

Perhaps the best example of this is in Alaska. Although Alaska moved early to prohibit salmon farming, farmed salmon supplies now exceed wild catches world-

wide. Salmon farming has developed rapidly in other countries irrespective of Alaska's prohibition. This has happened because aquaculture development worldwide is being driven by strong fundamental economic trends. According the Food and Agricultural Organization, wild fisheries landings for direct human consumption have been flat since the late 1980s. Seafood demand is increasing, per capita consumption of seafood in the United States alone has risen 1.8 pounds since 2001. World aquaculture production has increased steadily from 20.8 million metric tons (MMT) in 1994 to over 40 mmt in 2003. Whether the U.S. allows offshore aquaculture development or not, experts expect these trends to continue.

Countries like China, Japan, Norway, Canada, and Ireland have embraced aquaculture development as a way to supply domestic markets, diversify coastal economies, preserve working waterfronts, employ fishermen displaced by conservation measures, secure national food supplies and address trade imbalances through increased exports. The choice we have is not will aquaculture expand but whether we as a Nation want to be producers or consumers. For all of the reasons cited above I would argue we need to be producers to protect our countries interests and give working waterfront families another way to continue their maritime heritage.

2. If Someone Else Does It, Environmental Risk Will Be Larger

Like any human activity, aquaculture involves risk and can have environmental impacts. With good science, political will and technical expertise impacts can be prevented and/or mitigated. Achieving a balance between conservation and economic development is possible. In Maine, we currently have some of the strictest aquaculture environmental regulations and monitoring requirements in the world. We also have the most extensive and diverse marine aquaculture sector of any State in the Nation. I have worked in 14 different countries growing over 15 species using a number of different production methods. I have seen firsthand both the potential and the risks aquaculture development poses. If aquaculture is only allowed to develop overseas it will develop in jurisdictions that often have no environmental standards or enforcement. The environmental risk and potential damage of those operations will be much larger than operations allowed to develop in the U.S. under the framework proposed in S. 1195. If the environmental community is sincere about its environmental concerns it should support S. 1195 and work to ensure that any environmental regulations promulgated as a result achieve a reasonable balance between environmental protection and sustainable development. If S. 1195 fails or environmental restrictions are so severe that no investment occurs, we will all bear the responsibility of increased environmental impacts in jurisdictions with lesser environmental oversight.

3. Build it and They Will Come Is Not Enough

S. 1195 authorizes the Secretary of Commerce to establish a policy framework and rules designed to facilitate aquaculture development in the EEZ. It is an important first step. It will not in and of itself ensure investment and aquaculture development. Investment and development will only occur if the business community has confidence that its investments will be safe and will yield a reasonable return.

Investor confidence is impacted by many factors. One of these is the level of commitment demonstrated and resources allocated by government to business development. Our competitors in other producing regions have aggressive regional and national aquaculture development programs that support and promote aquaculture development. Last year, for example, the Canadian province of Nova Scotia spent $45 million to support and promote the development of marine aquaculture. In Ireland, where aquaculture is viewed as a rural development tool, an entrepreneur starting an aquaculture business can get 30 percent of their initial capital investment as an outright grant. Not a loan, not a loan guarantee, but a grant. In Japan, whose coastlines are already highly developed, local prefectures (similar to our states) spend millions of dollars each year to support and assist local aquaculture cooperatives.

NOAA Fisheries is a professional, hard working group of natural resource managers. With limited resources and multiple challenges they do a difficult job under very difficult circumstances. Currently, the Division has over 50 percent of its staff persons working on protected resources and endangered species. The remaining staff is principally involved in research and management of commercial fisheries The focus of most of this work is related to stock assessments, reductions in fishing capacity and allocation of resources between various constituencies. NOAA fisheries predecessor NMFS did play an important development role for the decade after the passage of the original Magnuson-Stevens Act. If the potential of S. 1195 is to be realized, the U.S. must invest significant funds in a targeted National Aquaculture Development Program. This program should not focus on research or demonstration projects but on commercial aquaculture development and support. This program

should include funds and personnel who are responsible for assisting potential aquaculture entrepreneurs in project development and permitting. The program should have a financing component to assist with start-up funds and the development of investment incentive programs. We did it for land-based agriculture and commercial fisheries. These sectors are now vital to our rural economies and national security. We need to do the same for domestic aquaculture development so that it too can contribute to our Nation's future.

4. Balanced Development Between Commercial Fisheries and Aquaculture Is Achievable

A number of groups have regularly asserted that commercial fishing and aquaculture constituencies are inherently in conflict. These assertions generally focus on conflicts over space, market share or potential environmental impacts. Conflicts over space and potential environmental impacts can be addressed through appropriate permitting and monitoring procedures. We have done it for twenty years in Maine. If we can do it in near shore locations in Maine with significant commercial fisheries, diverse and healthy marine ecosystems, extensive recreational use and commercial shipping, it can be done in the EEZ. It takes time, patience, hard work and agency resources, but it can and has been done successfully.

Conflicts over markets are more complicated. Aquaculture and wild fisheries products have at times competed in the market. Seafood markets have changed dramatically in the last twenty years. International and domestic distribution channels are more efficient. Consumers demand a diverse array of product forms that must be high quality, consistently available at a reasonable price. The most effective way to address market conflicts is through product differentiation, market segmentation and market expansion. This is happening very fast in seafood markets and aquaculture companies are leading the way in these trends.

Whether aquaculture products are produced in the U.S. or overseas have little to do with whether these products compete with wild products. As highlighted in Point 1 above, the United States has a choice. We can either allow the development of domestic aquaculture, help it compete with overseas producers and ensure a balance between commercial fishing and aquaculture interests. Conversely, we can prohibit domestic aquaculture and force our domestic commercial fisheries to compete directly with low cost unregulated overseas aquaculture production.

Specific Comments

1. Page 5, Line 19

Strike "*belonging to sedentary species*". There are a number of invertebrate species such as scallops, some gastropods, urchins, etc. that would not be classified as strictly sedentary nor would they be cultured in a structure. If only sedentary species are allowed on the seabed or in the subsoil, these species would be precluded for coverage under the statute. A number of these species have significant economic potential and should not be inadvertently excluded.

2. Page 10, Lines 15, 16, and 17

Site permits are initially issued for 10 years and then upon renewal drop to 5 year periods. Both the initial and the renewal periods are too short. Investment levels required for aquaculture operations in the EEZ will be relatively high and the time required to apply for permits relatively long. Initial investments will likely be over $1 million with permitting time-frames in years, not months. Investors who choose to pursue operations in the EEZ will need permit lengths significantly longer to provide regulatory stability, investment security and adequate payback periods. Permits should be for at least 25 years. Renewals should be automatic unless significant objections are raised and those objections are based on substantive technical grounds. Permits being renewed should be for the same or longer time periods than originally granted because the operator has a track record to examine. If permit holders have been bad operators, the agency has a powerful way to deal with permit violations through a strongly worded revocation for cause clause.

3. Pages 10 and 11

The current draft establishes the need for two permits; a site permit and an operating permit. These are in addition to a number of already existing Federal permits from other agencies. In instances where the site permit holder and the operating entity are the same, two permits are unnecessary. In those instances, one site permit that addresses agency concerns should be enough. Two permits will significantly increase the amount of time and expense required of the aquaculture entrepreneur. As long as the site permit addresses agency concerns and includes language that

protects the public trust and the environment, an additional operating permit would be unnecessary.

4. Page 12

During the permit review process, S. 1195 requires the Secretary to consult with other Federal agencies. S. 1195 further requires (Page 9, Line 1) that the Secretary renders a permit decision within 120 days of the application being deemed complete. S. 1195 contains no requirement for a timely reply by other Federal agencies to the Secretary's request for consultation and review. S. 1195 should establish a time shorter than 120 days within which other Federal agencies must reply to the Secretary. This requirement should include a provision which clarifies that a lack of reply within that time period constitutes agreement by the other Federal agency to the permits issuance. If regional fisheries management councils are consulted, this provision should apply to them as well.

Specific Comments on Amendments

Amendment SA 769

State Opt-out. As written, SA 769 would significantly reduce investor confidence and decrease the likelihood of investment due to its impact on investment security. Any aquaculture operation that has gone through all the permitting processes and is being operated responsibly and in good faith could have its license to do business revoked *without cause on 30 days notice.* No investor is likely to move forward with a project with that level of uncertainty and risk.

If a state wants to opt-out as a matter of policy *prior* to the initiation of any permit applications, it should have the right to do that. As that opt-out will have direct impacts on the economic potential of Federal waters that all U.S. citizens have an interest in said state should be required to justify the grounds for the opt-out and document the economic impacts of the opt-out on the national economy.

Amendment SA 1727

The purpose of this amendment appears to be to delay or preclude the implementation of S. 1195. This amendment does not propose any requirement that is substantively more protective than S. 1195. This amendment, if included, will result in years of delays and investment will occur overseas. The amendment will not in any way defend its assumed constituents (domestic commercial fishing interests) because they will continue to have to compete with overseas production.

I thank you for your attention and patience.

Senator SUNUNU. Thank you very much. I would like to begin with any questions or comments from Chairman Stevens.

STATEMENT OF HON. TED STEVENS, U.S. SENATOR FROM ALASKA

Senator STEVENS. Mr. Chairman, I said I didn't have an opening statement. I do have a summary, really, of comments I made. Plus, I'd like to put into the record a summary of the bill itself, S. 1195, that Senator Inouye and I introduced at the request of the Administration and the amendments that we filed at the time we introduced it, including the opt-out amendment that Mr. Belle has just commented on. My only comment would be that while it may be that amendment needs some clarification, clearly it should be the right of a state that has wild fish to protect its fish without an economic analysis just on the basis of the sheer right to protect it. I do believe that we have half the coastline of the United States. We harvest 60 percent of all the commercial fish harvested in the Untied States on the waters off of the Untied States, and that amendment would allow a portion of the coastline off of Alaska to be excluded from the concept of aquaculture while at the same time permitting other areas to be used if it was consistent with the problems of our wild fish. I, myself, doubt seriously that we would ever be able to protect wild fish if we had aquaculture off of our shores. I have told the Chairman that I just learned last week that I

should refer to mariculture when I refer to the shellfish. Is that right, Bill?

Dr. HOGARTH. Yes, sir.

Senator STEVENS. So, all of you have only been talking about fish, not about shellfish.

Dr. HOGARTH. We have talked about both. Most of the shellfish fisheries are directed by the state because they are in state waters.

Senator STEVENS. Well, I only want to state the amendments we filed will not impact mariculture. They only impact aquaculture, as I understand it. We do not seek to prohibit shellfish-types of mariculture off of our shores, as I understand it. Is that right, Mr. Vinsel?

Mr. VINSEL. Yes, that is the term we use in Alaska. Mariculture for shellfish, and we do have thriving shellfish mariculture, as many other states do, with very minimal problems, both to the environment or the existing fisheries. The finfish are our big concern.

Senator STEVENS. I have never been told of any conflict between the shellfish mariculture and our wild fish production.

Mr. VINSEL. We do not see any within the United Fishermen of Alaska, and we generally get along with the shellfish farmers and support their activities, and they're well-guided with the Department of Fish and Game.

Senator STEVENS. Dr. Hogarth, do you agree with the statement that I just made?

Dr. HOGARTH. Senator Stevens, basically yes. This bill is only for offshore. It has no effect on what the states are doing in state waters. This is only in the Federal waters.

Senator STEVENS. Well, our amendment goes beyond that, Bill.

Dr. HOGARTH. Right.

Senator STEVENS. Yes, and I am saying in that area, which is—you describe as Federal waters, in that area, mariculture is not inconsistent with the production of wild fish, as I understand it.

Dr. HOGARTH. No.

Senator STEVENS. Thank you.

Senator SUNUNU. Thank you, Mr. Chairman. Senator Boxer.

Senator BOXER. I mean, I—we don't have any problem with the shellfish. We think it's actually helpful, Dr. Goldburg, could you talk a little more about the levels of PCBs and other contaminants in farmed fish? What dangers could they pose to human health, if any? What could we do to prevent them? What are some of the problems and risks of using excess antibiotics to treat farmed fish? So, I mean I'm just looking to you to talk about the antibiotics, the PCB issue, and how these relate to public health.

Dr. GOLDBURG. Absolutely. I'll first talk about environmental contaminants in farmed fish. There have been a number of environmental contaminants documented in farmed fish that are carcinogenic. These include PCBs, dioxins, and a number of pesticides. And there are now several studies in the scientific literature concerning these contaminants, which show that at least in some farmed fish that have diets high in fish meal and oil, the contaminants can be at levels at which the EPA would advise very little consumption of those fish.

Senator BOXER. So, does this come from the food that is fed to these fish?

Dr. GOLDBURG. It absolutely appears to come from the food that's fed to the fish. And it is possible to grow a farmed fish without high levels of contaminants by reducing fish meal and oil levels, by very careful sourcing of feed ingredients, by using some emerging technology to clean fish oil before it's put in fish feeds, but NOAA's proposal does not consider any of those technologies and the need to produce really safe food——

Senator BOXER. OK.

Dr. GOLDBURG.—for American consumers. People want to eat seafood because of health benefits.

Senator BOXER. So, you don't think that the bill that was requested by the Administration addresses this issue at all.

Dr. GOLDBURG. I don't see any mention of it.

Senator BOXER. OK, and the antibiotic issue?

Dr. GOLDBURG. Well, antibiotics are used in aquaculture around the world when fish get sick. Use of antibiotics in animals, be they fish or terrestrial animals, can result in the proliferation of antibiotic-resistant bacteria. This was a big concern in Norway a decade or two ago when salmon farming started and was using very large amounts of antibiotics. And it was well-documented that antibiotic-resistant bacteria were turning up in blue mussels near fish farms, were turning up in wild fish near the fish farms that people were catching, and the Norwegians, to their credit, developed some vaccines for farmed salmon to reduce antibiotic use. But we have enough problems with antibiotic resistance now that—clearly critical medicines that we have to protect the efficacy of. And if we're going to go forward with large-scale fish farming that's essentially patterned on the poultry industry and the salmon farming industry, we need to do it in a way that absolutely minimizes or eliminates drug use.

Senator BOXER. Well, doctor, I would love to work with you further on this as we—if we move forward with this bill, Mr. Chairman, because I think, you know, the irony of it is that Mr. Cates talks about his children, yes. I mean, that's what it's about, and we need to protect our children and make sure that what we are doing here at the end of the day is healthful, isn't harmful to them and to the wild fish. The irony is we could have a system if we're not careful, Mr. Chairman, that winds up reducing, you know, the wild fish and getting our people sick. This is not an alternative. As I said already in California, we have got people going to the restaurants and saying if it isn't wild fish, don't put it on my plate. I mean—and I know California is usually first with these things, but this will spread, and I just don't want to see that happen. I don't want to see your investments go down the tubes. I mean, that's—so we need to do something that's good for everybody. Dr. Hogarth, I have concerns about NOAA's budget. Perhaps you can explain this to me. The Senior Scientist for NOAA's National Centers for Coastal Ocean Science, Dr. Paul Sandifer, first said it would cost $3 million a year to get an aquaculture program off the ground, and continuing costs would be $7 million. How will NOAA have the ability to effectively enforce its program when just this year NOAA's requested a 65 percent decrease in funding for its current marine aquaculture program, a decrease from the $4.5 million it received in appropriations in 2006. It's going to go down to

$1.6 million. So, I don't see how we embark on this expansion, this whole program even with all—and I hope that we would get it to a place where we could all be proud of it—if NOAA's budget is slashed like this. So, can you explain to me how you're going to do this. You going to cut other programs and put more money in this? What's your plan?

Dr. HOGARTH. Well, Senator Boxer, this is a priority of the Administration. And if we get the bill passed so that we can begin to work—I think one thing I really need to clarify very quickly is that this bill was to put into place the comprehensive framework to enable the U.S. to go into offshore aquaculture. It was not intended to have all the detailed criteria. This will be done through preparing a programmatic environmental impact statement and developing regulations in conjunction with the public, with the fishery management councils, with the states, with the NGO's.

Senator BOXER. That's a lot of work, sir.

Dr. HOGARTH. It's a lot of work. It'll probably take about 2 years to do at a cost of about $2.2 to $2.3 million a year.

Senator BOXER. So, you're saying that if this bill passes the Administration will reprogram and ask us for more money to do it.

Dr. HOGARTH. Well, If this bill passes, we will work with the Administration to get the money that's necessary. We have some funds within our budget, and we'll work through the budget process to ensure that it is done accurately.

Senator BOXER. Well, good luck doing that. I certainly would want to help on that, but we have got a hard time at the moment, and you only have $1.6 million, you have cut this program down. So, if this is a priority of the Administration, they don't seem to have much faith in their own bill because they're certainly not prepared for it, but we'll talk more about that. Can I have a second round after——

Senator SUNUNU. Well, yes.

Senator BOXER. I mean after everybody.

Senator SUNUNU. A vote has begun——

Senator BOXER. OK.

Senator SUNUNU.—but we have——

Senator BOXER. I'll wait.

Senator SUNUNU.—probably 15 minutes.

Senator BOXER. I'll wait.

Senator SUNUNU. I will, if time permits, have a second round, but I would like to turn to Senator Inouye.

Senator INOUYE. Thank you very much. I have been listening to the testimony very carefully, and terms such as invasive species, genetic contamination, environmental contamination are used quite often. Do we have technology at this time that can ensure that the wild stocks are protected from this type of contamination, Dr. Hogarth or anyone here?

Dr. HOGARTH. I'll take the first stab. I think definitely we do, yes, and I think the U.S. would be much more concerned about what is used in aquaculture. Now, we import fish from abroad which we know have chemicals that we do not allow in this country to be utilized. So, all those would be taken into account in the permits that we issue. The siting will be looked at very carefully and then we do another permit for operations. We think the technology

that's being developed for our industry now would definitely be an improvement over the technology for cages that has been used in the past. We are also working very hard with the soybean industry and others to develop feed that would not have to be so dependent on using fish. And we also, in the permitting, will approve whatever species are utilized. And so, we will not allow species that we feel would be harmful to the environment if there were some escapes, which we think we could control. So, all of that is part of the permitting process—what's utilized, where they're sited. You know, we have about 3.4 million square miles of waters in the EEZ. So, we're talking about less than 1 percent that would be utilized to produce a million tons of aquaculture species, which is less than probably all of the national marine sanctuaries put together. So, I mean it's a small area is what I'm trying to get across, that would be utilized. And we will handle all this through the permitting process, through the regulations and through a programmatic EIS, but we feel like the issues that have been raised can definitely be taken into account as we move forward with offshore aquaculture. The technology is developing. That's one reason we think that some of this should not be legislated, but should be part of the regulations because the permit can be changed to take into account any issues you see plus the technology as it develops. So, the permit and the regulations we feel are better. Thank you.

Senator INOUYE. Mr. Cates, you have been involved in this business for some time. What are your thoughts?

Mr. CATES. Thank you for letting me respond to that. It's quite difficult sitting here listening to this dialogue when I lived and breathed this industry for nearly 7 years. The real world experience for me in Hawaii is we have not used any antibiotics, any vaccines. And prior to me being able to even use that, I would have to get approval from the State of Hawaii. We have not had any disease, any of those issues. We use only fish native to Hawaii, which I'm a firm believer in. That's one way to mitigate invasive species and that issue. So, I think as I'm hearing all this, my sense is there are solutions to all of these concerns, and we need to take the first step. And I think back when our country decided to enter into space, we didn't have all the answers. But our country made it a conscious decision to try, and that's kind of where we are right now. Some will argue don't proceed until you have all the answers. Well, we're a new industry. We're going to make mistakes, but we can overcome those challenges. We can give our best effort. And I think the regulations and rules that are in place ensure that we're entering into this cautiously, and we're taking a first step. Also, we're saying let us provide some funding to answer a lot of these concerns, but we're not going to be able to answer them until we take the step. We have a lot of learning to do. Thank you.

Senator INOUYE. Dr. Goldburg?

Dr. GOLDBURG. There are technologies available to address some of the problems, but certainly not all of them. If we're going to proceed in this direction, we need a lot more technology development. And to my mind, we need environmental requirements that ensure that facilities do not go forward unless they meet some strong environmental standards for protecting the environment and fisheries. I think that one of the things NOAA could do that would be very

helpful would be to ask the question what will happen if we're successful and we really get a large offshore aquaculture industry that meets our goals, what are the potential impacts of that industry, and how do we frame a regulatory program to deal with those potential impacts. Unfortunately, the potential cumulative impacts of the industry have not been addressed to this point, and I think that that's really important to do before we go forward—to look at where we have technological answers, where we don't, and how we frame a system that will result in healthy oceans as well as more farmed fish.

Mr. VINSEL. Specifically, some problems that haven't been solved—the escapes. Even in Norway, which is really the world's leader in salmon fish farming, there was an escape of 500,000 this September. That was millions and millions of dollars, and an escape like that anywhere near Alaska would have serious impact. Another one is sea lice. It's well-documented that there are concentrations of sea lice around the fish farms of British Columbia, and these do affect Alaska salmon already that pass through that area. And another is our concern with the wastes, these non-point-source cumulative effects added, you know, together, whether it's, you know, lawn chemicals, oil and gas washing off our roadbeds—all of these things add up to cause harm to our oceans, and these are pointed out by the Pew Oceans Commission and the U.S. Commission on Ocean Policy. And the trouble with increasing those in a major way with large-scale net pen fish farms is that is not able to be attributed back, you know, to hold responsible the different sources. And so, you keep adding them together. And any single entity may not be the cause of decline in fisheries, but added together, if they are—Alaska's coastal communities don't have other options. And if harm is done and it's not able to be compensated for in some way—which brings us to a whole another question I'm not going to go to. I personally don't think it's possible to compensate for damage done to our fisheries, but these are grave concerns for Alaska's fishermen.

Senator INOUYE. Thank you.

Senator SUNUNU. Mr. Belle, why don't we pick up there, talk about the Maine experience on some of these very specific concerns. Disease, what's been the experience with——

Mr. BELLE. Well, I——

Senator SUNUNU.—the 30 years working in Maine, and any impact on any domestic wild fish species?

Mr. BELLE. True, thank you very much. As Randy alluded to earlier, it's difficult to sit here when you live and breathe this industry and listen to all this stuff. A lot of what we have talked about from the concerned point-of-view is based on the early history in the salmon farming industry and principally overseas. In Maine, we have had disease issues on salmon farms, and we have dealt with them, I think, very effectively. There has not been a single documented case in Maine of a wild fish being infected by any disease organism that was detected on a farm. It has not happened, and we have looked extensively. The Federal and State governments have both looked extensively. With respect to antibiotic use, we are more strictly regulated with antibiotic use than your family physician, OK? We have to have prescriptions. We have to have resist-

ance tests done on the pathogens that are detected. We can only use an antibiotic under very limited circumstances, and we have many farms in Maine that have never used antibiotics.

Senator SUNUNU. Are farmed fish tested for contamination levels, or PCBs as was mentioned specifically. Are they tested for contamination levels of PCB? What has been the history?

Mr. BELLE. The fish grown in Maine and in other parts of the country are tested by FDA as part of their market basket study. And we, like many farmers in the world, always look at feed ingredients and have learned some hard lessons in the last few years. We have certainly changed the way we formulate feed based on what some of the data coming out of the study says, and we now have very proscriptive feed contracts that require testing of feed ingredients and testing of the finished fish. It's kind of—there's—I think—to put things in perspective, think about this—if you have an animal that you husband for its entire life span, that you can control what it feeds and what it doesn't feed versus an animal that you have no control over what it's exposed to, where it goes, or what it eats—ultimately, which animal are you going to be able to control the toxins and contaminant levels in? It's a pretty intuitive thing. And I think both wild and aquaculture folks in the seafood industry are very concerned about toxins and contaminants, and I think both groups are working very hard to try to minimize any exposure to the consumer.

Senator SUNUNU. Dr. Langan, do you measure water quality at the 30-acre site off the coast?

Dr. LANGAN. Yes, we do. We have a very rigorous monitoring program capable of detecting even small changes in water quality conditions. We also look at the sediments to see if we're changing the organic content of the sediments, the oxygen levels in the sediments, and we also look for changes in the biological communities.

Senator SUNUNU. What do you see, and to what degree are you able to minimize the impact or control that water quality?

Dr. LANGAN. Well, we don't see any difference whatsoever between our reference stations, our stations directly under the cage or in the near field zone. And we have defined these zones by doing some modeling studies and projecting where particulate materials may be dispersed and settle. There was mention from one of the other panelists of cumulative impacts. There are modeling tools that allow us to predict where particles are going to go, and then we can verify this with our sampling program. But we don't see any difference whatsoever. We can't detect any changes as a result of our operations.

Senator SUNUNU. I don't want to say really, but you can't detect any significant difference in water quality, and do you think that that type of performance can be replicated even in expanded operations?

Dr. LANGAN. Well, we don't know that for sure yet. I think we do need to look at gradually increasing production at these demonstration farms so that we're approaching commercial size. But I think that based on what effects we see relative to what we are putting in the water in terms of fish feed and what we're generating in terms of fish wastes, we could use modeling capabilities to

predict what type of changes you might expect to see as a result of expanded farming operations.

Senator SUNUNU. Mr. Cates, do you measure water quality, and what do you see? You know, how many fish do you harvest a year? I know you gave a tonnage or a pound level.

Mr. CATES. Yes, we have had over a million pounds. My farm is——

Senator SUNUNU. How many fish a year is this?

Mr. CATES. About 1.8 million.

Senator SUNUNU. A million fish a year?

Mr. CATES. Yes, but we raise them until they are about three-quarters of a pound.

Senator SUNUNU. OK. Go ahead and——

Mr. CATES. So, our water is——

Senator SUNUNU.—talk about water quality and measuring water quality and measuring contamination levels.

Mr. CATES. Correct. First of all, our farm is undoubtedly the largest-scale open ocean farm in the U.S. We have raised the most fish to date. When we started our business, the Federal Government provided some funding to look at this issue. And ironically, their budget was double of my start-up budget. So, they spent an incredible amount of time and energy looking for water quality. After several years, the bottom line of what they found is at about 50 feet from my operation, it was almost unmeasurable, and it frustrated the scientists greatly. And in fact, above current were higher levels of nitrogen and other things, that was very confusing to them. And the reason that they came up with this is because of the algae that grows on our cages is a filter. And so, we have, you know, looked at this issue, and it really comes down to a scale. What we are talking about is at what scale, and a lot of the problems that you're referring to have been in coastal waters and closed areas. When you go in the EEZ, it's a different area. And to end that point is in Norway, their large $1.8 billion-a-year industry—the total square footage of all their cages combined is about the size of a large airport runway. And when you put that in the EEZ, it's different. When I hear references about if this industry reaches to the scale, we're talking about its equivalent to a city of 17 million people. But that's not in one location, that's spread out throughout the whole EEZ, which is enormous. And so, it's a little misleading.

Senator SUNUNU. I think your point is a very fair one. To my understanding, the EEZ and its aggregate is roughly the size of the continental United States. I have one final question before giving the last comment to Senator Boxer. There was a point raised by Senator Snowe, and I think it's an important one. Dr. Hogarth, you talked about one—I think you used the phrase one-stop shopping, at least with the permitting, but it's a two-stage permitting process. There is one for siting and one for operations. What's the rationale there, and does it make sense? Whatever standards we set, you know, we want the standards to be reasonable. That's important. A lot of questions have been raised here. But once we set those requirements, is there any reason not to integrate the permitting process?

Dr. HOGARTH. Well, I think the—basically, that's what we—we think it is important to site these facilities properly. And we think

once you site these properly, you need some certainty in a siting permit. From the operation standpoint, if a person decides he wants to change species, you know, if he wanted to go from summer flounder to king mackerel or something, then we don't think he should have to go through the whole permitting process again. You would utilize the operations permit. The operations permit would set the conditions for monitoring and for the type of species you can utilize, things like that. The day-to-day operations are covered in that permit, and that can be changed quicker, we think, than going back to the entire siting permit. Because if you go into the bank, the business people need certainty that they have a site to utilize for at least 10 years, and that's what we are trying to do. Yes, sir.

Senator SUNUNU. Mr. Belle, does that dual-siting cause problems, or do you see, at least from a business perspective, economic risk to having that two-stage process?

Mr. BELLE. Well, in my written testimony, I expressed some concern about the two permit approach. And basically, the reason is that in my experience, any time you add another permit, you at least double permitting time and maybe quadruple it, depending on what the permit is. Now, if, as Dr. Hogarth has related, the intent of the Department is to allow the operating permit to be amended in a shorter time frame, then that may not be an issue. And it makes some sense to allow some flexibility in terms of how operations change over time, but I would for sure need to see the specifics around that before I signed on.

Senator SUNUNU. Thank you. I appreciate all of your time. I'm going to submit Senator Snowe's additional questions for you to respond on the record. And Senator Boxer, any closing comments?

Senator BOXER. Yes, very briefly because we do have a vote. First of all, thank you, everyone. You have been terrific. I just—all of you. I would like to place in the record a number of things. First is this report called *Marine Aquaculture in the U.S.* prepared for the Pew Oceans Commission, the pages nine and ten that deal with disease and parasites. If I might do that, Mr. Chairman?

Senator SUNUNU. That will be included in the record.

[The information referred to follows:]

MARINE AQUACULTURE IN THE UNITED STATES

Disease and Parasites

Many diseases and parasites are capable of spreading between farmed fish and wild stocks. Historically, a number of diseases and parasites were introduced through aquaculture operations, and aquaculture can magnify the level of those diseases already present (NMFS/FWS, 2000). In the early 1900s, for example, the Japanese oyster drill and a predatory flatworm were introduced to the West Coast with the Pacific oyster, and at that time they contributed to the decline of native oyster stocks (Clugston, 1990). Accidental disease and parasite introductions are now much better controlled, but recent experiences in salmon and shrimp farming indicate that problems remain.

Some disease outbreaks on salmon farms appear to impact wild populations today. Sea lice—parasites that eat salmon flesh—are a serious problem on salmon farms and can even kill fish (McVicar, 1997; Finstad et al., 2000). Norwegian field studies observe that wild salmon often become heavily infected with sea lice while migrating through coastal waters (Finstad et al., 2000), with the highest infection levels occurring in salmon-farming areas (McVicar, 1997; Hindar, 2001).While these parasites are relatively common, sea lice epidemics have occurred in wild salmon and trout in every major salmon-farming country (Finstad et al., 2000). Sea lice may

also serve as a host for other lethal diseases, such as Infectious Salmon Anemia (ISA) (Johnson et al., 1997).

In January 2001, ISA was detected for the first time in the United States at a Maine salmon farm, and has since shown up in two more farms (Journal, 2001). ISA appears to be moving south from New Brunswick, where it made its first North American appearance in 1996. Since then, the disease has been detected in both escaped farmed fish and wild fish (FWS/NOAA, 2000; NMFS/FWS 2000). To protect Maine's Atlantic salmon from ISA and other introduced diseases, the National Marine Fisheries Service (NMFS) is considering mandatory escape-prevention and sea-lice control measures (NMFS/FWS, 2000).

Farmed shrimp also experience elevated disease incidence because the animals are often raised in high densities and are physiologically stressed. During the 1990s, the shrimp-farming industry in the United States and abroad was rocked by viral diseases that spread throughout the world, costing the industry an average of one billion dollars yearly since 1994 (Lightner, 1998). The presence of at least two of these shrimp viruses has now been documented in wild shrimp in the Gulf of Mexico (JSA, 1997; Ray, pers. comm.). However, marine viruses are little studied and there is only one known example—the "IHHN" virus in Mexico—where shrimp farm outbreaks might have depressed wild shrimp populations (JSA, 1997).

To reduce the effects of biological pollution, aquaculture facilities can grow fish that are unlikely to harm wild fish populations. Raising native fish species is generally preferable to raising non-natives unless escaped non-natives are unable to survive and reproduce outside of the farm (e.g., due to cold winters). Problematic genetic interactions can be reduced by farming fish away from endangered or threatened populations of the same species, and by escape-proofing facilities (FWS/NOAA, 2000). Options for minimizing escapes include using improved cage and pond designs, and moving fish out of netpens and into land-based facilities.

Stocking certified pathogen-free fish, reducing fish stress, and filtering or ozonating effluent from pond and recirculating tank systems can minimize disease transmission. The state of Texas requires shrimp facilities with virus problems to retain their wastewater until viral particles become inactive (Ray, pers. comm.).

Senator BOXER. Just to quote briefly, a Norwegian field study has observed that wild salmon often become heavily infected with sea lice while migrating through coastal waters, with the highest infection levels occurring in salmon farming areas. While these parasites are relatively common, sea lice epidemics have occurred in wild salmon and trout in every major salmon farming country. Sea lice can serve as a host for other lethal diseases such as infectious salmon anemia. Because I don't think we should understate what we are facing here, and I think—to say to Mr. Cates, you know, you may do best practices. A lot of this is not aimed at the people who do best practices. We want to emulate you. I certainly do. I want to work with my co-chair here to make sure that we have a bill that emulates best practices. OK, a letter of concern from the California Coastal Commission. I would ask that we put that in the record.

Senator SUNUNU. Without objection.

[The information referred to follows:]

CALIFORNIA COASTAL COMMISSION
San Francisco, CA, April 5, 2006

Hon. TED STEVENS,
Chairman,

Hon. DANIEL K. INOUYE,
Co-Chairman,

Senate Committee on Commerce, Science, and Transportation
Washington, DC.

RE: NATIONAL OCEAN AQUACULTURE ACT OF 2005, S. 1195

Dear Senators Stevens and Inouye,

The Coastal Commission staff appreciates the opportunity to comment on S. 1195. We are concerned about a lack of governance at the Federal level over open ocean

aquaculture, and we applaud your willingness to address this absence with the currently proposed legislation. We feel, however, that the bill should be much stronger in certain essential aspects, as described below.

The staff of the Coastal Commission has a number of concerns about S. 1195. The first is the legislation results in weakened environmental protection standards that will adversely affect marine and coastal resources. The second concern is that the legislation contains Federal preemption provisions that will eliminate the right of coastal states to enforce stricter environmental protection relative to aquaculture development. If ocean aquaculture is not conducted with extensive environmental safeguards, it can cause serious environmental degradation. The primary environmental effects of finfish aquaculture include:

- *Biological Pollution.* Fish that escape from fish pens may harm wild fish populations through competition and interbreeding, or by spreading diseases and parasites. Farming non-native species, transgenic or genetically modified fish should be prohibited.
- *Fish Feed.* Some types of aquaculture use large quantities of wild-caught fish as feed ingredients, thus potentially causing overfishing of low-trophic "forage" fish such as anchovies and sardines. Alternatives to use of fishmeal and fish oil should be required.
- *Organic Pollution and Eutrophication.* Aquaculture can lead to nutrient loading through discharges of fish wastes and uneaten food. An aquaculture operator should be required to provide baseline benthic habitat assessments before installation, regular monitoring, and site remediation after the project has ceased operations.
- *Chemical Pollution.* The variety of chemicals used in aquaculture, such as antibiotics and pesticides, should be monitored frequently, and minimized.
- *Use Conflicts.* The physical structures can conflict with commercial and recreational fishing activities.

We respectfully urge you to include in S. 1 195 standards that result in avoidance or reduction of these significant adverse marine and coastal effects.

In addition, we strongly oppose the preemption of states' rights resulting from S. 1195. Pursuant to the Coastal Zone Management Act of 1972, states have the ability to adopt coastal zone management programs, and regulate ocean development such as aquaculture. State standards may indeed be stronger than the provisions contained in S. 1195, and that important concept must not be lost here. The Coastal Commission respectfully requests that our concerns be addressed in the legislation.

Sincerely,

PETER M. DOUGLAS,
Executive Director.

Senator BOXER. A letter from all over the country signed by 53 different organizations expressing concern, a letter from Oceana expressing concern, a letter from the Pacific Coast Federation of Fishermen expressing concern, a letter from everyone from Alaska—Longline Fishermen to Reef Relief and United Anglers. Many organizations here expressing concern, and a letter from The Ocean Conservancy. If I could put those in the record* and say to you, Mr. Chairman, I know that you are fair, and you're a good legislator, and I think we have enough information to guide us in writing a bill that will be a win for everybody.

Senator SUNUNU. Thank you very much. Again, thank you to the panelists. I apologize that we have this responsibility to vote, but it is what it is. So, we appreciate your testimony and your expertise and look forward to following up with you in the record. The hearing is adjourned.

[Whereupon, at 11:19 a.m., the hearing was adjourned.]

*The information referred to is printed in the Appendix.

A P P E N D I X

PREPARED STATEMENT OF HON. FRANK R. LAUTENBERG,
U.S. SENATOR FROM NEW JERSEY

Mr. Chairman, thank you for holding this hearing on an important issue. I look forward to hearing from our diverse panel of witnesses.

One of the best things about a visit to the Jersey Shore is the seafood. You can enjoy clams, shrimp, scallops and fish, fresh from the ocean. Many people agree that aquaculture can play a role in putting seafood on the table for American families. Perhaps it can even help us reduce our trade deficit with other nations.

However, offshore aquaculture raises serious environmental concerns and poses risks that need to be addressed up front, not after the fact. Fixing a problem is always more expensive than doing it right the first time. I understand that Senators Stevens and Inouye have introduced this bill at the request of the Bush Administration. I am concerned that the Administration's bill does not do enough to address concerns about offshore aquaculture raised by the U.S. Oceans Commission, the Pew Oceans Commission, and others.

I am also concerned that we do not yet have sufficient understanding of how offshore aquaculture might affect our commercial and recreational fishing industries, which are important to New Jersey and other states. I hope our Committee can work in a bipartisan fashion to ensure that any aquaculture bill contains strong safeguards for fish species and marine habitats, and that its potential impacts on recreational and commercial fishing are fully considered.

Thank you Mr. Chairman, and thank you to our witnesses for joining us today.

INTERNATIONAL GAME FISH ASSOCIATION, MARINE FISHERIES ADVISORY COMMITTEE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (DOC)—OFFSHORE AQUACULTURE ACT—RESOLUTION (MARCH 3, 2006)

The Marine Fisheries Advisory Committee (the Committee), in light of:

1. The growing scientific recognition of the health benefits of seafood;
2. The growing dependence of the U.S. on imports and the resulting trade deficit to meet growing demand;
3. The increasing recognition of the importance of food security in today's world;
4. The opportunity to conduct commercial aquaculture in the Exclusive Economic Zone (EEZ) consistent with environmental, conservation and protected species goals;
5. The opportunity to provide direct economic benefits to coastal communities through development or expansion of shore-based support services and complementary economic strategies and incentives.
6. The opportunity to establish mechanisms for cultured and wild market development and education (e.g. marketing councils); and
7. The opportunity for U.S. leadership to develop, test and implement best practices for offshore aquaculture; therefore

The Committee strongly supports the need for legislation to authorize establishment of a regulatory framework to permit commercial aquaculture in the EEZ.

PREPARED STATEMENT OF BRUCE S. ANDERSON, PH.D., PRESIDENT,
OCEANIC INSTITUTE

Mr. Chairman,

We greatly appreciate the opportunity to provide testimony to you and the Subcommittee on the pending open ocean aquaculture legislation, lessons learned from

our research and experiences in Hawaii, areas of need, and the potential benefits of this technology to the Nation.

The Oceanic Institute (OI) is a nonprofit, private research organization dedicated to marine aquaculture, biotechnology, and coastal resource management. Our mission is to provide biologically, economically, and environmentally sustainable technologies, products, and services that are required to increase aquatic food production to meet growing national and world needs. With over 100 employees located at our main facility on the island of Oahu, OI is recognized worldwide for its significant contributions to research and development of shrimp and marine fish aquaculture, aquatic feeds and nutrition, and marine stock enhancement and environmental management.

For the past 7 years, OI, in partnership with the University of Hawaii, the State of Hawaii, and commercial collaborators has been conducting offshore aquaculture research under the NOAA-funded Hawaii Offshore Aquaculture Research Project (HOARP). These efforts led to the first successful demonstration of offshore aquaculture in the U.S., and the establishment of the country's first commercial offshore farm. Hawaii is in the national spotlight of offshore aquaculture development, with two commercial farms operational, and at least one other farm in early stages of permit approval. The lessons learned and experiences gained provide a basis for comment and vested interest in the development of responsible approaches toward this important technology.

The science and technology to support offshore aquaculture is still in the early developmental stages. The fledgling offshore industry in Hawaii is faced with a number of challenges and issues that need to be effectively addressed. To date, I believe the companies that are pursing open ocean aquaculture in Hawaii have done so responsibly. Nevertheless, reasonable safeguards need to be established in legislation and through rulemaking if we expect it to grow in a sustainable manner in the United States, but they should not be unduly constraining to the industry.

The lessons learned in Hawaii should be carefully considered in developing Federal legislation that will allow leasing of public lands for aquaculture. Indeed, the most important policy decision made by states that support aquaculture, including Hawaii and Florida, is that aquaculture is "in the public interest." This enabled those states to lease public lands for this purpose. In doing so, these states used existing authorities and developed new regulations, when necessary, to ensure that public health and safety and concerns about environmental impacts were addressed. An extensive public participation process helps to assure that siting and user conflicts were identified and addressed by the permittee. The concept of "shared use" helped mitigate concerns that the leased lands would be used exclusively for aquaculture.

In Hawaii, the Department of Land and Natural Resources, has the authority to issue leases of state land. In that respect, it served much the way that NOAA would serve in the proposed legislation. A key to Hawaii's success in permitting these facilities was that no attempt was made to transfer authorities from one agency to another. For example, the State Department of Health has delegated responsibility from the Federal EPA to issue NPDES permits. An NPDES permit was issued by the DOH to control water pollution from open ocean facilities. Other permitting and regulatory authorities remained with the responsible agencies.

When the subject of aquaculture arises, conversation invariably ends with a discussion about the sustainability of the industry and availability of feeds to support the industry. The use of fishmeal has become a key topic of debate. Although many animal production systems rely on fishmeal and fish oil as components of diets, the aquaculture sector is particularly vulnerable since supplies are limited and very few alternative ingredients have been identified for this sector. Projections for use for aquaculture alone worldwide in 2015 are roughly 75 percent and 145 percent, respectively, of the existing fishmeal and fish oil supplies. Hawaii currently imports all of its aquaculture feeds, and with shipping costs expected to rise substantially with rising fuel costs, feedstocks will be one of the most critical items limiting the long-term sustainability of offshore aquaculture in our state.

Further research on aquatic feeds is needed to ensure that the offshore aquaculture is sustainable. This should include research on alternative feeds, development of guidance and best management practices to maximize the substitution in aquaculture feeds of alternatives to fish meal and oil derived from directed reduction fisheries, including:

- Seafood processing wastes and unavoidable fisheries bycatch;
- Cultured marine algae and other microbial sources of omega-3 fatty-acids;
- Crop plants and other terrestrial protein sources; and
- Other products produced in an environmentally sustainable manner.

Prior to feedstocks becoming an issue, however, is the need to consolidate existing hatchery and production technologies of the farmed species. Although Hawaii leads the Nation in the number of offshore farms, the methods used to establish broodstock, raise seedstock, and guard against disease are still in their early stages of development. Farms are beginning to experience hatchery production and disease bottlenecks that require solid, scientific investigation. These problems need to be resolved before the industry can significantly expand. Sustainability requires constant vigilance and improvement and has been the basic tenet of all other successful animal agriculture systems in the U.S. today. The more we know about a species, the better its production can be managed, and the more efficient production will be.

Key environmental issues that face the industry include concerns about water pollution and other effluent impacts, potential genetic and biological interactions with escaped farmed fish, diseases and parasites that may be present in the wild that could affect farmed fish and vice versa, and marine wildlife interactions.

Environmental monitoring of facilities in Hawaii has shown that water pollution impacts are negligible down-current of existing cages. Nevertheless, cumulative impacts of multiple cages and expansive growth of the industry needs to be carefully monitored. New methods need to be developed to assess those impacts based on sound science.

Genetic interactions between wild fish and those that escape from cages has been a very controversial issue, particularly as it applies to the salmon fisheries. It is strongly recommended that offshore aquaculture be limited to species of the genotype native to the geographic region. However, programs need not be based on wild broodstock exclusively. This would severely limit the potential for reducing the costs and improving the efficiency of offshore aquaculture production in the long-term. Animals can be bred for faster growth, improved feed utilization and survival, disease resistance, etc., that have the biggest impact on break-even costs of offshore operations. Moreover, selective breeding can be done responsibly to ensure that the genetic make-up of wild stocks is not adversely affected if (and when) an accidental release happens.

Selective breeding has been the major reason for improved growth and production of all other animal agriculture systems and is being applied in other aquaculture sectors. A case in point is the growing $9 billion worldwide shrimp farming industry. Disease is so rampant among wild broodstock that the world is now rapidly moving to domesticated animals bred for disease resistance and other economic characteristics. Development of disease- (or specific pathogen-free broodstock for selective breeding, and biosecurity protocols to assist that development will be key to the long-term future of offshore aquaculture as well.

It is also recommended for the long-term that a national program of research be established with centers across the country that are tied together and focused working on key regional issues that parallel national needs. The work needs to be well-funded, focused, and responsive to industry needs. The key areas of research addressed above include:

- Culture (new species; hatchery scale-up; selective breeding and broodstock management; nutritional requirements, alternative feeds and ingredients, grow-out densities, etc.);
- Disease—of hatchery and offshore growout (pathology, diagnostics, epidemiology, treatment, biosecurity);
- Environmental—addressing genetic as well as organic pollution issues (explained above).

These areas of research critical to the development of this nascent industry are not well funded by the government and the private sector is not in a position to devote the resources necessary to adequately address these issues.

It is well recognized worldwide that capture harvest of wild fisheries has reached critical levels and will not be sustainable into the next decade. With a seafood deficit currently at $8 billion, the U.S. faces critical issues in being able to meet growing domestic seafood demands. Great strides have been made in marine aquaculture technologies in the past decade, and it is now possible to produce many species of fish in land-based intensive culture systems at costs that are substantially below those of harvesting wild stocks. Yet, substantial expansion of land-based aquaculture is limited due to competing interests for suitable land and because of environmental concerns. Offshore aquaculture production has been viewed as a means toward meeting future seafood demands in an environmentally-acceptable way. It will be the ability to develop capacity (culture research), avoid disease (disease research), and minimize risk to wild stocks (genetics research), and the environment (organic pollution research) that will determine the size of this industry in the fu-

ture and what it can do on economic returns, the Nation's food supply, and balance of trade.

We deeply appreciate the opportunity to provide our perspective on this important issue and hope these viewpoints are looked upon favorably as the legislation moves forward.

PREPARED STATEMENT OF NEIL ANTHONY SIMS, PRESIDENT, KONA BLUE

Dear Senators,

Kona Blue would like to offer the following testimony in relation to the "National Offshore Aquaculture Act of 2005" and amendments.

Kona Blue is the first integrated offshore fish farm and marine hatchery in the U.S. Our operation is based a half-mile off the Kona Coast, in waters over 200 ft. deep. We are culturing sashimi-grade Kona Kampachi™. This species is considered a trash fish in the wild, and so we do not compete with commercial fisheries. As we control the fish's diet from hatch-to-harvest, we are able to produce a superb product, rich in heart-healthy Omega-3 fatty-acids, and with no detectable mercury and no detectable PCBs (at detection levels more than 20 times the sensitivity of FDA's "unlimited consumption" levels).

We are growing a product that is incredibly appealing; it is tasty, it is the epitome of healthy eating, and it is produced in an environmentally-sound manner. Monthly tests have found no discernible difference between the up-current and the down-current water quality around our offshore pens. We have stocked over 140,000 fish into our cages over the last year. Presently, we are harvesting around 8,000 lbs per week, and we have fish in the water to produce over 25,000 lbs per week by the end of this year.

Our operation in State waters is, we believe, an excellent example of what could eventually happen in Federal waters if this bill is passed. We would like to lend our support for the bill.

This nascent industry represents both an opportunity, and an imperative. It is an opportunity to grow healthful, tasty products in pristine offshore waters, without impinging on other user group interests in nearshore areas. It is an opportunity for the U.S. to show innovation and leadership in an area that offers huge growth potential. It is an opportunity for the U.S. to develop codes of practice and environmental standards that could be more broadly applied, to the betterment of all the world's oceans, and all the world's consumers.

Open ocean aquaculture is also an imperative. Our oceans have been plundered for too long. As a former fisheries biologist, once charged with the discouraging task of managing commercial fisheries on depauperate coral atolls in the South Pacific, I have a keen insight into the limitations of fishing wild stocks. Aquaculture is clearly the only viable solution to increasing demand for high-value fish and other marine products. And the open ocean is the ideal realm for supporting this needed growth. Rather than simply taking from Nature, we must ourselves start to nurture.

The fundamental message is that open ocean fish farming *does* work. Our Kona Kampachi™ are testament to this fact.

There are certainly challenges, both now, and in the future. New engineering technologies are needed for efficient and safe operation in the offshore realm, and major research efforts need to be focused onto hatchery production and grow-out technologies for new fish species that could diversify the industry. Perhaps most importantly, the projected growth in aquaculture worldwide means that alternative sustainable feed sources need to be developed.

Private companies such as Kona Blue and Cates International are already pioneering the development of this industry by essentially investing in prototypes that will be scaleable in Federal waters. By year's end, Kona Blue will have invested $8M in venture-capital to bring our operation from plan to profitability.

However, venture-capital-funded start-up companies alone will not solve the challenges we face. There is a clear and pressing need for Federal research funds to support the development of this industry. Federal support for offshore aquaculture research is abysmally low. Previous sources of research funding that might have assisted (Advanced Technology Program under NIST, Saltonstall-Kennedy Grant Program under NMFS) have been zeroed out in the last few years. NOAA had a total of only $4M available this year, and received over 220 applications for research support for open ocean aquaculture development. There needs to be recognition of the potential for U.S. leadership in this industry. Federal research funding should be concomitant with that recognition, and with the size of the U.S. seafood market (around $55 billion).

I would like to provide our perspective, as a functioning offshore fish farm, on two specific areas of opposition to aquaculture in the U.S. EEZ: the potential environmental impacts of fish farms, and the issue of the sustainability of culturing carnivorous fish.

First, our project has demonstrated that the potential environmental impacts of offshore fish farms are negligible, *provided* that projects are sited properly and operated correctly. How are we to ensure that such a condition is adhered to? There is already an extensively-tested process for review of projects through NEPA, and this should become part of the review process for open ocean aquaculture projects proposed in the EEZ waters. As Hawaii's experience shows, the public review process works well. The pathway provides ample opportunity for public input. The public review and consultation that is part of the EA/EIS process has been shown capable of identifying project proponents who have selected a less-favorable site, or not fully thought through the community's concerns, or who have not invested sufficient time with the various stakeholders to assess what these concerns might be. The experience here in Hawaii should assure the public that similar processes in Federal waters will provide adequate opportunity to address the salient public health and safety, siting and use conflicts, and environmental and biodiversity concerns for each project, as it is proposed. These processes should be transparent to the public, and there should be a single, central coordinating Federal agency that oversees the review and approval process.

While the culture of carnivorous fish is much-maligned, the feedstocks issue should not constrain industry development—or cloud your decisionmaking—now. As a company committed to sustainability in all our endeavors, we recognize that feedstock supplies are indeed a concern in the long-term. Current sources of supply of fish meal and fish oil are stable, yes, but they are certainly not scaleable. To be truly sustainable, we must be able to assure future generations that the practices we adopt can continue.

Recognizing this, our company—in partnership with several feed companies—is expending considerable funds and effort into developing replacement diets for our Kona Kampachi™. We are striving to incorporate more agricultural grains into our fish diets, as well as by-products from other seafood processing. Achieving this goal will not only render our operations more sustainable and profitable in the long-term, but will also have economic and environmental benefits to the broader America, beyond the ocean's shores. Wider use of agricultural grains will bring real economic opportunity to the breadbasket of America (the sources of soy, wheat, canola and other protein or oil crops). In addition, waste streams from processing of wild-caught seafood is presently underutilized, with much of it being diverted to cat food or chicken food, or sent to fish farms in Japan or China. Offshore aquaculture is the best possible use of these by-product proteins and lipids from both an environmental and an economic perspective.

Considerable, concerted research is needed to address the challenges of feeding a growing industry, and a Nation hungry for great seafood. We believe—and we are sure that you will agree—that a vibrant, innovative offshore fish farming industry is the best engine to drive the necessary research for resolving these future bottlenecks in global feedstock supplies. The U.S. offshore aquaculture industry should not be hamstrung because of these concerns, but should rather be encouraged to partner with other U.S. industries to address these issues proactively. Significant Federal support for this critical long-term research need is also both appropriate, and necessary.

Thank you for your consideration, *aloha*.

ALASKA LONGLINE FISHERMEN'S ASSOCIATION; CENTER FOR FOOD SAFETY; COOK INLET KEEPER; ENVIRONMENT MAINE; ENVIRONMENT MATTERS; ENVIRONMENTAL DEFENSE; ENVIRONMENTAL DEFENSE CENTER; FLORIDA FISHERMEN'S FEDERATION; FRIENDS OF CASCO BAY; GO WILD CAMPAIGN; GRACE PUBLIC FUND; GREENPEACE; GULF RESTORATION NETWORK; HAWAII AUDUBON SOCIETY; INSTITUTE FOR AGRICULTURE AND TRADE POLICY; KAHEA; MANGROVE ACTION PROJECT; MARYLAND CONSERVATION COUNCIL; NATIONAL ENVIRONMENTAL TRUST; NATURAL RESOURCES DEFENSE COUNCIL; THE OCEAN CONSERVANCY; OCEANA; PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS; PCC NATURAL MARKETS/SOUND CONSUMER; PUBLIC CITIZEN; SIERRA CLUB; REEF RELIEF; SOUTHEASTERN FISHERIES ASSOCIATION; SOUTHERN OFFSHORE FISHING ASSOCIATION; UNITED ANGLERS OF CALIFORNIA; U.S. SALMON NETWORK; UNITED SOUTHEAST ALASKA GILLNETTERS; VERSAGGI SHRIMP CORPORATION; WHALE CENTER OF NEW ENGLAND

May 24, 2005

Hon. TED STEVENS,
Hon. DANIEL INOUYE,
Hon. OLYMPIA SNOWE,
Hon. MARIA CANTWELL,
U.S. Senate,
Washington, DC.

Hon. RICHARD POMBO,
Hon. NICK RAHALL,
Hon. WAYNE GILCHREST,
Hon. FRANK PALLONE, JR.,
House of Representatives,
Washington, DC.

RE: PROTECT OCEAN HEALTH AND ENSURE RESPONSIBLE GOVERNANCE, DO NOT SUPPORT NOAA'S OFFSHORE AQUACULTURE BILL

Dear Chairs and Ranking Members,

To protect our oceans, native fish populations, and human health and livelihoods, the above groups urge your leadership to ensure legislation to promote aquaculture in offshore ocean waters is governed by a strict regime of scientifically sound regulations. The National Oceanic and Atmospheric Administration (NOAA) has drafted legislation that it intends to soon transmit to Capitol Hill to promote offshore aquaculture in the U.S. Exclusive Economic Zone. We are concerned that this legislation is not adequately protective of our oceans, including fisheries and other ocean uses. We hope you will work with us to ensure that any offshore aquaculture legislation introduced protects all ocean interests.

Fish farming and other forms of aquaculture have received widespread attention, including as posited as a solution to dwindling wild stocks and the growing U.S. seafood trade deficit. The Department of Commerce has called for a five-fold increase in domestic aquaculture production by 2025. We recognize that some types of aquaculture offer potential benefits. However, without comprehensive Federal permitting requirements, offshore aquaculture poses numerous serious risks to marine ecosystems, native fish stocks, and public health. Offshore finfish farms are vulnerable to the escape of farmed fish, which may interbreed with and alter the genetic makeup of local fish populations. Fish farms concentrate parasites and diseases, which can spread to other fish. Antibiotics and other chemicals used to treat or prevent these diseases can bring unintended consequences. Large quantities of uneaten fish feed and wastes are discharged from farms directly into ocean waters and may pollute the surrounding ecosystems.

Moreover, we question claims that offshore aquaculture supplements dwindling fish stocks and will reduce the Nation's "seafood deficit." Most marine finfish are carnivores and currently require large quantities of fisheries products, made largely from wild-caught fish, in their diets. Farming these marine finfish actually reduces the net supply of fish. In this way, aquaculture diminishes rather than adds to fish supplies, and although it might reduce the U.S. seafood deficit in monetary terms, it does not reduce it in ecological terms. Moreover, NOAA has not justified its economic claims for reducing the U.S. seafood trade deficit.

Significantly, NOAA's proposal does not provide adequate safeguards to ensure our oceans, fisheries, ecosystems and public health are protected. NOAA has rejected Congressional and stakeholder comments to include specific precautions and provide further necessary study in conjunction with its legislation, including requests that the Agency comply with the National Environmental Policy Act (NEPA)

by completing a Legislative Environmental Impact Statement before submitting its legislation to Congress. Rather than comply with NEPA, NOAA has ignored these requests dating from late 2003.

Based on our understanding of NOAA's proposed legislation, specific concerns shared by our groups include:

- Almost total discretion given to NOAA regarding permits and conditions;
- No coordination with other offshore uses such as navigation, recreation, defense, or fishing except "to the extent practicable;"
- Lack of baseline environmental protections for incorporation within permits;
- Allowance of genetically modified and non-native fish species that may compete with and cause harm to native populations;
- No clear process for public or state government participation in the consideration of permits;
- Lack of detailed provisions as required of other offshore industries making the permittee responsible for the life of the offshore structures, and providing for general financial and environmental risks, including bankruptcy;
- Lack of critical implementation language regarding enforcement and no provisions for citizen suits;
- Absence of rapid response provisions for known risks, such as disease outbreaks.

Two recent national commissions, the U.S. Commission on Ocean Policy and the Pew Oceans Commission, recommended that ocean uses be better managed and coordinated. NOAA's bill does not accomplish such coordination, nor does it adequately protect our oceans. For these reasons, we urge you to forgo sponsorship of NOAA's proposal at this time, and to only support legislation which provides sufficient parameters to ensure our oceans and fisheries are protected, and to ensure that any aquaculture facilities in public waters enhance, not diminish, our food supply.

Sincerely,

Catherine Hazlewood, *The Ocean Conservancy, Washington, DC.*
Tracie Letterman, *Center for Food Safety, Washington, DC.*
Becky Goldburg, Ph.D., *Environmental Defense, Boston, MA.*
Zeke Grader, *Pacific Coast Federation of Fishermen's Associations, San Francisco, CA.*
Marianne Cufone, *Environment Matters, Tampa, FL.*
Andrianna Natsoulas, *Public Citizen, Washington, DC.*
Bob Jones, *Southeastern Fisheries Association, Tallahassee, FL.*
Robert Spaeth, *Southern Offshore Fishing Association, Madeira Beach, FL.*
Cyn Sarthou, *Gulf Restoration Network, New Orleans, LA.*
Mark Ritchie, *Institute for Agriculture & Trade Policy, U.S. Salmon Network, Minneapolis, MN.*
Sal Versaggi, *Versaggi Shrimp Corporation, Tampa, FL.*
Kate Wing, *Natural Resources Defense Council, San Francisco, CA.*
Mike Hirshfield Ph.D., *Oceana, Washington, DC.*
Anne Mosness, *Go Wild Campaign, Bellingham, WA.*
Linda Behnken, *Alaska Longline Fishermen's Association, Sitka, AK.*
Linda Paul, *Hawaii Audubon Society, Honolulu, HI.*
Eric Wickham, *Canadian Sablefish Association, Vancouver, BC Canada.*
Caroline Karp, *Sierra Club, Exeter, RI.*
Kenneth Duckett, *United Southeast Alaska Gillnetters, Ketchikan, AK.*
Matthew Davis, *Environment Maine, Portland, ME.*
Bob Shavelson, *Cook Inlet Keeper, Homer, AK.*
Tracy Wolpert, Randy Lee, Trudy Bialic, *PCC Natural Markets/Sound Consumer, Seattle, WA.*
Andrea Kavanagh, *National Environmental Trust, Washington, DC.*
Ray Pringle, *Florida Fishermen's Federation, Panacea, FL.*
Cha Smith, *KAHEA, The Hawaiian Environmental Alliance, Honolulu, HI.*
Joseph E. Payne, *Casco Baykeeper, Friends of Casco Bay, South Portland, ME.*
Alfredo Quarto, *Mangrove Action Project, Port Angeles, WA.*
Alice Slater, *GRACE Public Fund, New York, NY.*
Paul G. Johnson, *Reef Relief, Crawfordville, FL.*
Mason Weinrich, *Whale Center of New England, Gloucester, MA.*
Bob Strickland, *United Anglers of California, San Jose, CA.*
Mary P. Marsh, *Maryland Conservation Council, Annapolis, MD.*

Brian Trautwein, *Environmental Defense Center, Santa Barbara, CA.*
John Hocevar, *Greenpeace, Washington, DC.*

PREPARED STATEMENT OF THE OCEAN CONSERVANCY

We are writing to register The Ocean Conservancy's (TOC) concerns regarding the National Offshore Aquaculture Act of 2005 (S. 1195) as introduced, and to offer recommendations for improving the bill. While the development of offshore aquaculture may have significant potential, it also has significant risks. To protect human health, native fish and wildlife populations, and ocean ecosystems, TOC believes that aquaculture in ocean waters must be accompanied by a stringent statutory and regulatory framework.

We appreciate your efforts, as well as those of many of your colleagues, to ensure environmental standards are developed to accompany any legislative authorization of this new ocean use. As it stands, S. 1195 is strongly weighted toward the promotion of commerce. It fails to provide adequate criteria and standards to guide NOAA in accounting for other interests, such as the protection of wild stocks, protection of the environment, and coordination of other uses. In fact, without your amendment upon introduction, even the duty to develop standards would have been left solely to the discretion of the agency.

In this context, we would appreciate your consideration of our comments on the bill as introduced. We look forward to working with you to develop a more effective and efficient management regime that will safeguard the environment and the public trust.

Background

The potential of open ocean aquaculture is promoted as a solution to the ocean's diminishing resources. However, it also poses significant risks, including escapement of fish, damage to the surrounding environment, harmful effects on native fish populations, and pollution. These risks, and their consequences, are largely dependent upon the location of the operation, its size or scope, the stringency and comprehensiveness of the management practices, the capacity of the receiving water body, and the choice of species to be raised in a particular area.

Both the Pew Oceans Commission and the U.S. Commission on Ocean Policy recommended that Congress improve the governance framework to address the many challenges and risks associated with the development of offshore aquaculture.

Risk of Escapement of Potentially Invasive Species

In our view, the single greatest ecological and economic threat associated with a rise in offshore aquaculture is the potential to introduce potentially invasive species to the surrounding ecosystem and nearby coastal communities. According to the National Marine Fisheries Service (NMFS) and the Fish and U.S. Wildlife Service (FWS), escapes are resulting in harmful interactions with native fish. These interactions include competition with wild stock for food, habitat and mates, genetic modification of wild stocks through inter-breeding, and transfer of potentially deadly diseases and parasites to wild stocks.

The potential for escapement of farmed fish is greater in facilities sited further offshore, where containment structures face increased exposure to wind and wave power as well as to predators. Offshore structures pose unique challenges for monitoring as well as rapid response in the event of escapement. Additionally, many of the species favored for offshore aquaculture use are highly pelagic, and consequently, once they escape, are capable of traveling thousands of miles.

Moreover, we currently have no way of determining in advance which species that escape into the wild are likely to cause harm. No common statutory definition of invasive species exists; nor has the Federal Government implemented comprehensive screening protocols to discern which non-native or genetically modified species have the potential to become invasive upon introduction into a given environment. Therefore, the utilization of non-native species in offshore aquaculture facilities is dangerously premature.

Additional Biological Threats

Offshore aquaculture presents numerous additional biological threats to ocean ecosystems. The excreta from an average floating cage farm can produce nutrients equal to a city of 7,500.[1] Depending upon pollutant composition and the cumulative

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[1] *See What's Behind That Farmed Salmon Steak?* Salmon Nation (2002) at *http://www.salmonnation.com/farmed.html,* citing David Suzuki Foundation, (2002) *Ocean Pollution*

effects of similar cages in a particular area, discharges may present harmful effects on the surrounding environment. Additionally, outbreaks of diseases and parasites are a constant risk because the density of fish in aquaculture operations is so much higher than in nature. Diseases in farmed salmon have been found to significantly threaten the health and vitality of nearby migrating wild stocks. Farmed species, depending upon species and diet, can even present increased public health risks to the people who consume them.[2]

Aquaculture operations also may require dredging, drilling, the use of large heavy anchors, and other disturbances to sediment and bottom habitats, which can displace ocean wildlife, smother bottom-dwelling animals, destroy hiding places for young fish, and cause other ecological changes to the sea floor. Finally, aquaculture may create an incentive to overexploit targeted wild fish populations to provide inexpensive feed for farmed fish.[3] Farming carnivorous marine fish such as salmon currently represents a net loss of fish protein.[4]

Lack of Capacity of Regulatory Regime to Address Risks

Unfortunately, current regulations and mitigation strategies are simply inadequate to guide the aquaculture industry or manage its risks. Regulatory agencies with overlapping and conflicting authority have thus far demonstrated significant confusion regarding environmental requirements, siting considerations, leasing procedures and jurisdictional responsibility. Without careful legislative coordination of NOAA's jurisdiction and responsibilities with those of other agencies, we believe problems will persist, with potentially serious environmental consequences.

For these reasons, clear, coordinated and comprehensive standards must accompany the development of this new ocean use. This is especially critical given the projected growth of the industry: the U.S. Department of Commerce has called for aquaculture production in the United States to increase fivefold by 2025.[5] In this context, the remainder of our comments will address our specific concerns with the bill as introduced, organized section-by-section.

Section 2. Findings

As currently drafted, the findings of Congressional policy in this section generally promote the development of aquaculture while incorporating too little acknowledgement of either its risks or its effects on other ocean uses. We encourage the Committee to ensure this policy reflects a more balanced perspective on the development of a new ocean use and its relationship to other ocean uses and the marine environment.

Section 3. Definitions

Section 3(1) defines "demonstration" to include both pilot scale-testing of aquaculture science and technologies, or farm-scale research. We believe generally this definition is too vague to give sufficient guidance. "[P]ilot scale," "science," "technologies," and "farm-scale research" are potentially subjective terms not defined further in the bill. We would encourage you to clarify these terms to ensure even demonstration projects are conducted in an ecologically protective manner.

Section 4. Offshore Aquaculture Permits

Generally speaking, we would like to see section 4 amended to provide a framework to ensure offshore aquaculture is well coordinated with other ocean uses and protects the public trust. This section directs the Secretary of Commerce to establish a site and operating permit process to make areas of the U.S. Exclusive Economic Zone (EEZ) available to persons to develop and operate offshore aquaculture facili-

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from Salmon Farming, http://www.davidsuzuki.org/Oceans/Fish_Farming/Salmon/Pollution.asp.

[2] *See* Hites, *et. al, Global Assessment of Organic Contaminants in Farmed Salmon,* 203 *Science* at 226 (concentrations of PCBs, toxaphene, and dieldrine have been found to be significantly greater in farmed salmon species than in wild species, and applications of risk indicates risks may detract from beneficial effects of consumption).

[3] "An annual production of 1 million mt of farm fish may require 1–5 million mt of compounded feed, depending upon its formula and conversion rates . . . For carnivorous fish, like most marine species, feeds contain proteins mostly of animal origin, particularly high quality fish meal and fish oil." *Achieving policy objectives to increase the value of the seafood industry in the United States: the technical feasibility and associated constraints,* C.E. Nash, 29 Food Policy 621–641 (2004).

[4] "[A]bout two to five times more wild-caught fish are used in feeds than are harvested from aquaculture," Future seascapes, fishing, and fish farming, R. Goldburg and R. Naylor, 3(1) *Front. Ecol Environ,* 21–28, p. 23 (2005).

[5] *See,* Biliana Cicin-Sain and Robert W. Knecht, *Development of a Policy Framework for Offshore Marine Aquaculture in the 3–200 Mile U.S. Ocean Zone* (2001).

ties. However, it leaves to agency discretion particular procedures to be followed, including timing of regulatory processes, and scope and criteria for decisions.

Legislation Should Include a Method for Initially Determining Suitable Areas for Aquaculture

We recommend that the Committee include a more comprehensive siting process than the proposed lease-by-lease, operation-by-operation approach. Although subsection (b) requires the Secretary to specify in a site permit the size and location of an offshore aquaculture facility and, under subsection (d), to consult with other Federal agencies to ensure that an offshore aquaculture facility is compatible with other uses of the EEZ, the bill lacks a mechanism to determine, in advance of individual operation-by-operation siting decisions, where offshore aquaculture is, and is not, appropriate. The process we envision would clearly articulate criteria and a process for NOAA to follow in establishing zones appropriate for development of aquaculture leases and operations that also would not interfere with other ocean uses, such as shipping channels and commercial fisheries.

Legislation Should Prohibit the Permitting of Commercial Operations Until NOAA has Promulgated Necessary Regulations

We also urge you to include language prohibiting the issuance of any aquaculture permits under this section until the agency has promulgated comprehensive regulations to guide its decision-making. The timely establishment of clear, consistent, and enforceable regulations is critical for both the public and industry.

Legislation Should Ban the Use of Non-native or Genetically Modified Species in Offshore Aquaculture

For the reasons articulated in the background section to these comments, we oppose the use of non-native or transgenic species in offshore aquaculture. Some states, including Maine, California, Washington and Oregon have already implemented such prohibitions in legislation to protect state waters, while other states such as Alaska more broadly prohibit the development of offshore aquaculture in state waters. We urge you to amend section 4 to prohibit the use of non-native species and transgenic species in section 4 of S. 1195.

Section 5. Environmental Requirements

Legislation Must Include Strong, Clear Operational and Site Permitting Requirements

We are concerned that S. 1195 establishes few parameters to guide agency consideration of the ecological impacts of aquaculture facilities. Although subsection (4)(c) authorizes the Secretary to issue operating permits under "such terms and conditions as the Secretary shall prescribe" and subsection (4)(d) directs the Secretary to "consult as appropriate" with other Federal agencies to ensure that offshore aquaculture facilities meet the environmental requirements established under section 5(a) of the bill, section 5(a) does not establish any new requirements. Instead, it simply directs the Secretary to consult with other Federal agencies to identify the environmental requirements applicable to offshore aquaculture under *existing* laws and regulations. Although the bill authorizes the Secretary to establish additional environmental requirements, the process for consultation with other stakeholders as well as the content of any such additional requirements is left to the discretion of the Secretary. Furthermore, subparagraph (d)(6) requires only that the Secretary "periodically review" the criteria for issuance of site and operating permits.

We recommend that the Committee include standards in the bill for siting and operating permits that are precautionary, comprehensive, clear, and legally binding. Specifically, we recommend that such standards address the following general issues:

Siting

- Description of site characteristics, and proximity to other ocean uses;
- Consideration of cumulative effects of similar facilities in an ecosystem;
- Prioritization of ocean uses such that aquaculture does not unreasonably interfere with other ocean uses, such as the protection of a sensitive marine environment, popular recreational fishery, or vessel lane used in commercial fishing;
- Requirements that facilities be designed and operated to prevent escapes and interactions with wild species.

Cultured Species

- Proposed sources for organisms to be grown at the site;

- Procedures for the introduction of fish stocks to stock facilities, including brood stock quarantine, limited introduction of first-generation progeny to assess interactions with native species in open waters, and continued study of the introduced organisms in their new environment;
- Maximum allowed density, numbers and biomass of fish allowed in a particular type of structure;
- Minimization of the use of fishmeal and fish oils in feeds.

Pollution Standards

- An analysis of the quality of the receiving waters (with bioassays, as appropriate). Analysis of the potential for pollutant transport by biological, physical or chemical processes, and availability of alternatives to pollutant discharge from the facility;
- Development and application of water quality criteria and pollutant effluent limits established by the Environmental Protection Agency under the Clean Water Act;
- Requirements that the use of drugs and chemicals be minimized and that detailed records be kept on all drugs and chemicals used in an aquaculture facility, including the amounts used and frequency applied. Drugs, pesticides, and other chemicals not authorized and registered by the Food and Drug Administration and the Environmental Protection Agency for the particular use should be specifically prohibited. In addition, drug and chemical records should be available to the public at all times;
- A detailed plan in the event of escapement to rapidly respond, including tagging and notification procedures.

Monitoring and Permitting

- Minimum standards for record keeping, including records of the total number of each species grown and harvested, and specific maintenance and inspection procedures carried out;
- Ongoing monitoring of benthic habitat and water quality both in and immediately surrounding the containment structure;
- Limitations on the duration of permits and a specific timeframe for review of criteria for the issuance of site and operating permits. Specifically, the legislation should provide for an initial period for an operating period that is economically and environmentally reasonable, not to exceed 8 years. Once that initial period has elapsed, operating permits should be reviewed and renewed at least every 5 years. Similarly, criteria for the issuance of site and operating permits should be reviewed not less than once every 4 years;
- Bonding procedures to ensure restoration of the site and financial liability of the owner/operator of the facility.

In sum, given the risks associated with offshore aquaculture, we believe it should be carefully regulated from its inception to ensure its economic and environmental success.

Section 6. Research and Development

S. 1195 allows the Secretary to conduct research and development to advance technologies that are compatible with the protection of marine ecosystems. We believe this work should be carried out in close coordination with other relevant agencies. We also note that while many international, national and state governments have implemented recommended management measures drawing upon existing science, NMFS has not yet promulgated best management practices under existing law. We urge the Committee to direct NMFS to develop and publish such research in time to help guide development and promulgation of regulations under section 4 of the bill.

Section 7. Administration

We believe S. 1195 should establish reasonable timelines and deadlines for the promulgation of regulations necessary to administer this program. As outlined earlier, we believe that the bill should make clear that permitting for commercial aquaculture facilities may not proceed until NMFS has promulgated those regulations.

Additionally, we request that the Committee amend subsection (c) to detail processes for resolving disputes that may that arise in decisionmaking. Other than requirements that the Secretary consult with other relevant agencies "as appropriate" (section 4(d)(1)) and the requirement to obtain "concurrence" (section 4(a)(2)) from

the Department of Interior on some decisions, the bill currently does not articulate a process for resolving interagency disputes.

Despite the language of subsection (f), subsection (g) takes the highly unusual step of authorizing the Secretary to apply the provisions of any other Federal statute to offshore aquaculture facilities if the Secretary determines that it is in the public interest. In our view, Congress, and not the Secretary, should determine in the first instance whether those laws apply to offshore aquaculture facilities.

Similarly, subsection (h) would Federalize the law of the nearest adjacent coastal states even for state laws that have not yet been adopted. Although we appreciate that state resources may be adversely affected by aquaculture operations in Federal waters, and support states' ability to adopt more stringent laws governing such facilities, subsection (h) is not an adequate substitute for a sufficiently comprehensive and stringent Federal program.

Section 8. Authorization of Appropriations

Section 8 authorizes to be appropriated to the Secretary such sums as are necessary to carry out the Act. Although this section gives the appropriators wide latitude, an authorization for a specific dollar amount in each of the Fiscal Years authorized by the Act would give the members of the appropriations committee and the public some indication of the resources needed to fully and effectively implement this program. We suggest that this section also include specific authorizations for research and the promulgation of regulations.

Section 10. Enforcement Provisions

We urge the Committee to clarify the circumstances and use of available enforcement authority. We urge the Committee to incorporate a citizen suit provision, similar to those utilized in other Federal statutes regulating biological pollution.

Section 11. Civil Enforcement and Permit Sanctions

We urge the Committee to consider including a liability in rem provision.

Section 13. Forfeitures

We urge the Committee to include language ensuring that forfeited resources made available for sale do not endanger public health.

Conclusion

Thank you for your efforts to ensure that offshore aquaculture is guided by strong environmental standards. We look forward to working with you to advance legislation that would ensure prudent, consistent, and responsible controls on the siting and operations of open ocean aquaculture facilities.

April 4, 2006

Hon. BARBARA BOXER,
Senate Committee on Commerce, Science, and Transportation,
Washington, DC.

Dear Senator Boxer:

In light of the upcoming Senate National Ocean Policy Study (NOPS) subcommittee hearing on offshore aquaculture, the undersigned organizations, representing consumer and conservation organizations, recreational and commercial fishing groups and business interests, would like to share our concerns about legislation to allow permitting of commercial offshore aquaculture in Federal waters without adequate safeguards for protecting marine ecosystems, wild-fish populations, consumer health and the economic livelihood of fishing businesses and communities. We therefore ask that you oppose the National Offshore Aquaculture Act (S. 1195)—introduced on June 8, 2005 at the request of the National Oceanic and Atmospheric Administration (NOAA)—and any similar future proposal until pertinent questions are answered.

We recognize that some types of aquaculture offer potential benefits; however, independent reports from two recent blue ribbon commissions, the U.S. Commission on Ocean Policy and the Pew Oceans Commission, highlight the threats that farming carnivorous finfish, such as cod, halibut and red snapper, can pose to the environment and native fish populations. The U.S. Commission on Ocean Policy's report cites numerous concerns, including the spread of disease and parasites; genetic "contamination" and competition between wild- and farmed-fish populations; degradation of water quality; harm to marine mammals; increased pressure on already-exploited fisheries from an increased demand for fishmeal and oil; and the possible introduction of non-native or genetically-modified species. The Pew Oceans Commis-

sion recommended a moratorium on offshore fish farming until such concerns are addressed.

The issues raised by offshore aquaculture development are not just environmental, but also include the impacts on fishermen and women. In the 1990s, increased imports of low-cost farmed salmon substantially depressed commercial salmon prices, contributing to financial instability for many fishing families and fisheries-dependent businesses. Yet NOAA appears to be promoting offshore aquaculture without consideration of such impacts. To our knowledge, NOAA has not analyzed the potential socioeconomic impacts of offshore aquaculture development, nor has the agency articulated a strategy to minimize or balance the impacts offshore aquaculture will have on the livelihoods of U.S. commercial fishermen and women.

S. 1195 gives NOAA the authority to issue permits for the construction of private fish farms, or marine aquaculture operations, in federal waters from three to 200 miles from shore. Unfortunately, this bill does not address the problems with offshore aquaculture and instead allows the Secretary of Commerce, in consultation with other Federal agencies, to fast-track the permitting of large commercial fish farms with little protection for the marine environment, consumers or fishing businesses and communities. For example, the bill fails to require the Secretary to conduct appropriate mapping, planning or zoning to minimize conflicting uses or protect sensitive areas and ecosystems. The bill gives the Secretary nearly unlimited discretion to determine the siting- and operating-permit conditions, including the environmental criteria, if any, that apply to facilities. It provides no requirements for tagging, tracking or monitoring of fish farms to assess their impacts on wild fisheries or on consumer health. Contrary to the laws of several states, the bill fails to prohibit the raising of genetically modified and non-native fish species, and it provides for little or no oversight from the public, states or fishery management councils.

Moreover, NOAA has refused repeated requests from a number of the organizations below to conduct a Legislative Environmental Impact Statement on the bill, as required by the National Environmental Policy Act, so that Congress can begin to assess the effects of offshore fish farming before voting on this major change to the management of our ocean resources.

In short, S. 1195 is an example of a bill that lacks safeguards necessary to protect marine ecosystems, including marine fisheries. We therefore urge you to oppose S. 1195. We would be happy to discuss our concerns further and to work with you to protect our oceans and America's fisheries.

Sincerely,

Organizations/Associations

George A. Kimbrell, *Center for Food Safety.*
Beth Fitzgerald, *Greenpeace USA.*
Wenonah Hauter, *Food and Water Watch.*
Gerry Leape, *National Environmental Trust.*
Kate Wing, *National Resource Defense Council.*
Tim Eichenberg, *The Ocean Conservancy.*
Caroline Gibson, *Pacific Marine Conservation Council.*
Linda Behnken, *Alaska Longline Fishermen's Association, AK.*
Dorothy Childers, *Alaska Marine Conservation Council, AK.*
Sharry Miller, *Prince William Soundkeeper, AK.*
Chris Zimmer, *Transboundary Watershed Alliance, AK.*
Kenneth Duckett, *United Southeast Alaska Gillnetters, AK.*
Becca Robbins, *Yukon River Drainage Fisheries Association, AK.*
Kathy Hansen, *Southeast Alaska Fishermen's Alliance, AK.*
John L. Wathen, *Hurricane Creekkeeper, Inc., AL.*
Erich Pfuehler, *Clean Water Action, CA.*
Dan Jacobson, *Environment California, CA.*
Nadananda, *Friends of the Eel River, CA.*
Marianne Cufone, *Environment Matters, FL.*
Frank Carl, Executive Director, *Savannah Riverkeeper, GA.*
Cha Smith, *KAHEA: The Hawaiian-Environmental Alliance, HI.*
Tracy Kuhns, *Association of Family Fishermen, LA.*
Cyn Sarthou, *Gulf Restoration Network, LA.*
Michael Roberts, *Louisiana Bayoukeeper, LA.*
Peter Baker, *Cape Cod Commercial Hook Fishermen's Association, MA.*
Marine and Fish Conservation Program, *Institute for Agriculture and Trade Policy, MN.*
Bill Schultz, *Raritan Riverkeeper, NJ.*
Ken Hinman, *National Coalition for Marine Conservation, VA.*

Alaska Independent Fishermen's Marketing, *Association, WA.*
Anne Mosness, *Go Wild Campaign, WA.*
Stephen Taufen, *Groundswell Fisheries Movement, WA.*
Alfredo Quarto, *Mangrove Action Project, WA.*
Chuck Owens, *Peninsula Citizens for the Protection of Whales, WA.*

Businesses

William T. Black, *F/V Carol M, AK.*
Gulkana Seafoods-Direct, AK.
Tom Waterer, *Nautilus Marine, Inc., AK.*
Norman Van Vactor, Bristol Bay Manager, *Peter Pan Seafoods, AK.*
William (Bill) Webber, *Webber Marine & Mfg., Inc., AK.*
Robert A. Bonanno, *F/V Night Train II, CA.*
Chris White, *F/V Vulcan, ID.*
Peter Girvan, *F/V Karma, UT.*
Paul Gilliland, Managing Director, *Bering Select Seafoods Company, WA.*
Nadine LaPira-Wolos, *Bristol Bay Wild 'N Red Salmon, WA.*
Clipper Seafoods, Ltd, WA.
Jay Follman, *F/V Erika Lynn, WA.*
Fisher's Choice Wild Salmon, WA.
Buck Meloy, *Flopping Fresh Fish Company, WA.*
John Jovanovich, *Jovanovich Supply Company, WA.*
Justin Marx, *Marx Imports, WA.*
Ron Richards, *F/V Ocean Dancer, WA.*
Tracy Wolpert, *Chief Executive Officer, PCC Natural Markets, WA.*
John R. Adams, *President, Seattle General Agency Inc., WA.*
Warren "Buck" Gibbons, *President, Wildcatch, Inc., WA.*

PREPARED STATEMENT OF THE PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS

At the urging of the National Oceanic & Atmospheric Administration (NOAA), Senate Bill 1195, the National Ocean Aquaculture Act of 2005 (NOAA Bill) was introduced last June. The Pacific Coast Federation of Fishermen's Associations and the Institute for Fisheries Resources write to oppose NOAA's NOAA Bill as currently drafted. [1]

Historic Overview

Aquaculture, or fish farming, has existed for some 3,000 years or more. In marine settings it is sometimes referred to as mariculture. It has been used for the rearing of fish, shellfish and aquatic plants for a portion of a species' life (*e.g.,* public mitigation hatcheries) or for the entire life of the species (*e.g.,* commercial salmon netpen operations). The Chinese, for example, often raised carp in ponds as an integral part of their other farming operations. Along France's Atlantic Coast, Bretons have cultured oysters for centuries. Trout farms (mostly private) have existed for more than a century in North America, used to stock lakes and rivers for sport fishing and produce food fish.

Since the 1870s, hatcheries (mostly public) have been built to supplement salmon runs, rearing fish for release into the wild. Salmon hatcheries have been widely used in the west to mitigate for fish losses attributable to the construction and operation of the large Federal dam projects. These hatcheries spawn adult fish returning from the wild, and hatch and raise the progeny anywhere from a few months to a year before releasing them into the wild. In some of the more "highly developed" (*i.e.,* dammed) watersheds, over half of the fish released in the wild may have come from hatchery production.

Although aquaculture in various forms has been around for thousands of years, a major push has come about in the past thirty years to greatly expand its scope and forms. Governments have begun looking for ways to supplement wild fish production, which in some cases has been stagnant or falling. Governments have promoted fish farms to create new jobs in high unemployment rural areas, much as Norway did when it began pushing salmon farms in coastal villages. Still others

[1] The Pacific Coast Federation of Fishermen's Associations represents working fishing men and women in the West Coast commercial fishing fleet. The Institute for Fisheries Resources is a non-profit organization dedicated to the protection and restoration of fish resources and the human economies that depend on them and is engaged in research, public outreach and education regarding marine and anadromous fish resources.

began calling for a "blue revolution," following agriculture's "green revolution" (or not so green), claiming it was needed to increase world food production.

Some large food corporations and grocery chains have been attracted to the controlled nature of aquaculture operations as a means of profiting from the public's appetite for such things as shrimp and salmon by providing these products without being limited to natural seasons. Mariculture has attracted fishery biologists as a tool to lure government or private research grants. Moreover, it has even caught the attention of oil companies looking for a use for their offshore platforms once the wells went dry. These companies, obligated under their leases to remove the old structures and clean up the seafloor, have looked for ways to use the structures for other purposes (*e.g.,* "rigs-to-reefs"), in order to evade their obligations under the leases and save the millions of dollars required for removal and clean-up.

If, in fact, aquaculture is a food production technology that has been around for centuries, with new operations utilizing cutting edge technology, and all this in furtherance of increasing food production and even taking pressure off wild fisheries which could help the U.S. reduce or eliminate its "seafood deficit," then what is the problem? Let's have a closer look.

The Nature of the Problems

Although aquaculture is currently the fastest-growing type of food production in the world, and holds the illusion of vastly increasing the world supply of fish, shellfish and aquatic plant life, it has a number of hazards that cannot be ignored. While the promise remains, the problems identified below call for a more careful approach to its development, where the pre-cautionary principle should be the guiding force.

1. *Pollution.* The use of net pens and other "open" systems (*e.g.,* cages) in the marine environment means waste from aquaculture operations ends up being disposed of, often in high concentrations, in open waters. Since the fish in such operations are highly concentrated, waste is a significant problem compared to that of fish in the wild. The situation is somewhat analogous to a comparison of the waste problem between a cattle feedlot and cattle grazing on open rangeland. Pollution from salmon netpen operations, for example, has created anaerobic conditions under the pens with nothing living on the seabed below. Pollution will also emanate from closed systems when the wastewater from aquaculture is not properly treated before being discharged. The pollution is generally attributed to three sources:

- *Fecal Material.* Fecal matter from highly concentrated numbers of fish in pens, or other forms of containment, builds up and cannot be readily absorbed by the environment (as it is when fish are swimmingly freely in the wild). A leading scientist that supports the aquaculture industry wrote a paper indicating that a fish farm of 200,000 fish produces as much of some types of sewage as almost 65,000 people. Many farms now have over 1,000,000 fish and British Columbia has over 100 farms.
- *Feed and Medicines.* Uneaten fish feed collects on the ocean floor. This uneaten feed in high concentrations, like fecal matter (which can also carry disease or parasites), can result in anaerobic conditions. Moreover, the feed may contain medicines intended for the farmed fish, such as antibiotics needed to combat disease when fish are held in concentrated situations over a period of time.
- *Pesticides/Fungicides*. Pesticides and fungicides are occasionally used in aquaculture operations to control parasites (such as sea lice that may attach to the fish), as an anti-fungal agent or to control algae and other growth on the meshes of net pens or other containment facilities. Even in oyster culture operations, usually considered sustainable and environmentally benign, there have been problems when growers (e.g., Willapa Bay and Grays Harbor, Washington) sprayed beds with the pesticide carbaryl, aimed at killing burrowing shrimp populations.

2. *Spread of Disease, Parasites.* Aquaculture operations in contact with the ocean environment can infect wild fish populations, putting native stocks at risk. There have been numerous instances where disease from trout farms has infected wild salmon in rivers. In California, wild populations of abalone were infected with and nearly destroyed by a disease called "withering foot syndrome" as a result of out planting of aquacultured abalone from South Africa. An infestation of sea lice from salmon netpen operations in British Columbia infected juvenile wild pink salmon, having a devastating impact on that population of native fish. These scenarios appear all over the world including in Norway and Scotland as the same open net pen technology is being employed throughout.

3. *Habitat Loss.* Some aquaculture operations have resulted in significant habitat losses. The types of losses vary with each operation. Salmon netpen facilities, as mentioned above, have damaged or destroyed seafloor ecosystems as a result of pol-

lution. The clearing of mangroves to establish farmed shrimp operations has acted to destroy these natural habitats for fish and other marine life, as well as eliminate important coastal barriers that provide low lying lands with protection from ocean storms and tsunamis.

4. *Escape.* The escape of farmed fish from finfish mariculture facilities is a frequent occurrence. Since their establishment along the eastern shore of Vancouver Island and the southern mainland waters, millions of Atlantic salmon have escaped from British Columbia mariculture farms. Netpens, anchored in coastal waters are the predominant type of facility used for farming salmon and are vulnerable to storms and accidents. In Scotland, over a million farmed salmon escaped in January 2004, following the storm damage done to the netpens and over a million farmed salmon escaped in July 2004 from farms in Chile, also due to severe storms. Programs to recover escaped farmed fish exist, but are only marginally successful. Moreover, as is the case in Canada, the costs for such programs are usually borne by taxpayers, not the aquaculturists.

At first blush, the escape of farmed fish into the wild may not seem to be a problem. Aren't hatchery fish, after all, released into the wild for purposes of mitigation or enhancement? The problem is the types of fish or shellfish being raised are not always the same as native stocks, and become non-native invasive species when they enter the wild. Atlantic salmon, for example, are neither native to the Pacific, nor the southern hemisphere, yet they are being raised in netpens in the Pacific in both the northern and southern hemispheres, where they can, and do, escape into the wild to compete with wild stocks or spread disease.

Even utilizing native broodstock in mariculture operations, as has been ordered in the State of Maine for salmon farms, does not completely address the escape problem. Farmed fish, after generations of being raised in aquaculture facilities, begin to differ genetically from their wild cousins through a process of directional selection. The end product, most notably, is the loss of genetic diversity and the traits needed for fish to survive in the wild. The four principle problems presented by escaped farmed fish are:

- *Predation*. Predation by farmed fish on native fish stocks, particularly juvenile wild fish, can be deleterious to wild populations. The introduction of farmed fish into the wild upsets existing marine ecosystem predator-prey relationships.
- *Competition*. Escaped farmed fish are potential competitors with wild fish for forage or habitat.
- *Interbreeding*. Where farmed fish are the same species as natives in the wild, there is a danger of their interbreeding. The problem here is that farmed fish, which may be lacking the traits for survival in the wild, could weaken wild populations through interbreeding. The interbreeding of hatchery and natural-spawning fish, for example, has led to changes in salmon hatchery practices. The problem is magnified, however, with farmed fish that, unlike hatchery fish, are intended to live their complete life in captivity and display fewer natural survival traits than fish released into the wild from hatcheries.
- *Colonization*. There is a danger, too, that escaped non-native fish can establish self-sustaining populations in the wild. In British Columbia, for example, despite denials by the government, Atlantic salmon have been found spawning in several B.C. streams, producing a second generation. It is not simply a matter of one type of salmon replacing another; the non-native invasive Atlantic salmon spawn at different times and in different numbers than Pacific salmon, causing further adverse effects on the natural balance.

Another issue related to escapes are plans for the use of genetically-engineered ("transgenic" or "genetically-modified") fish/shellfish in aquaculture operations. One U.S. Company, Aqua Bounty, is currently awaiting Food & Drug Administration approval for use of its genetically modified Atlantic salmon in fish farm operations. These fish are modified to grow up to seven times faster than a normal salmon through the introduction of a growth regulating gene from an Atlantic pout and a Pacific Chinook salmon.

The faster growth would allow fish farmers to bring fish to market much quicker and, in theory, reduce their costs. Aqua Bounty, which is working as well on genetically modified shrimp, has also submitted an application to the Canadian Government for approval of the use of its fish in that nation's salmon farms. Genetically modified zebra fish ("Glo Fish") have already been approved in most states for use in home aquariums (aquariums are a major source of aquatic invasive species). It is seen as just a matter of time before GE fish begin finding their way into aquaculture operations, whether in the U.S. or other nations.

It is nothing but foolhardy to allow genetically modified fish into the wild. The impact of GE fish getting loose into the wild from aquaculture operations is yet unknown, but the fact that it has been impossible to contain genetically modified corn or soy from spreading into the wild, does not bode well for attempts to prevent the spread of GE fish from aquaculture facilities into the wild, particularly from operations in coastal or open ocean waters.

5. *Displacement of Fishing Communities.* Aquaculture operations vie for space in coastal zones with traditional fishing operations. This competition for space has caused the displacement of fishing communities along the southern coast of Chile, where salmon farms have removed access to or destroyed fishing areas of Chile's artisanal fishermen. In much of Central America and South Asia, shrimp farms have also displaced fishermen. In California, proposed abalone farms in the middle of Pillar Point, just south of San Francisco, threaten to remove an anchorage needed by fishing vessels and pleasure craft seeking refuge from storms. Even in the open ocean, depending on placement, structures created for aquaculture operations could displace fishermen from critical fishing grounds.

6. *Impairment/Endangerment of Traditional Maritime Activities.* Depending on where and how they are located and the sheer number, aquaculture structures in the ocean could impede navigation and, as noted above, interfere with or impair fishing activities. Although not normally considered impairment, the location of visible aquaculture structures could also affect land values. The proposed wind farm offshore Cape Cod, for example, has drawn criticism for impairing views; the same could be said for certain types of aquaculture structures. Coastal and open ocean aquaculture structures, particularly those that are floating, could endanger fishing operations and maritime activities when the structures, on the surface or submerged, break loose and become navigational hazards.

7. *Net Loss of Protein.* Aquaculture is being promoted as a means of increasing the production of fish, thereby expanding the world's food supply. The problem is that much of the aquaculture taking place today, and most of that proposed for open ocean waters, will actually *decrease* the amount of edible, usable protein available. The types of mariculture being considered, from the tuna ranching "feed lots" (capturing tuna in the wild and holding and feeding them in pens, until suitably "fattened" for market), to coastal net pens and open ocean cages, involve finfish and most of those are carnivorous. This means these fish have to be fed other fish, usually a meal made into pellets from species such as menhaden, anchovy, herring, pilchards and other smaller fish. Yet even under the best feed-to-meat ratio, between 3:1 and 5:1 for salmon and 17:1 for tuna, for example, more of these small fish have to be harvested and processed to produce a lesser amount of the final product. As a result, fishing pressure actually intensifies on wild stocks instead of being reduced, causing an effect opposite to what the aquaculture proponents often claim.

Much of the fish being taken for meal, such as anchovy, herring and pilchards, are perfectly good fish in themselves for the dinner plate and are, in fact, the staple of the diet of many coastal communities. Industrial fishmeal fleets, in nations such as Peru, threaten the smaller artisanal fisheries that supply the local communities their food. This raises the question: Is aquaculture about impoverishing, or subjecting to malnutrition, communities in developing nations to feed gluttonous consumers in first world countries? Why grind up five pounds of good sardines or anchovy to get one pound of farmed salmon?

Aquaculture proponents point to the fact that salmon are one of the most efficient animals at converting feed to protein. The problem is they are converting usable protein to usable protein with a loss of about 70 percent in the conversion. Compare that to "less efficient" cattle that convert grass to protein, admittedly at much higher ratios, but are converting a feed (grass) to protein in ways that most other animals are incapable of doing, and the argument for salmon efficiency begins to break down. One of the solutions offered up to address the fishmeal issue has been to feed carnivorous fish more plant protein, such as soy, or convert the fish to herbivores. This is not really a solution, since soy, too, is a protein easily used by humans. Some alternatives such as creating meal from fish offal (instead of whole fish) and utilizing invasive fish and plants for meal may hold some promise, but whether it would meet the demand for vastly expanded aquaculture operations is highly speculative.

Aquaculturists' Arguments

The proponents of NOAA's NOAA Bill will make several erroneous arguments in support of their position. They include:

1. *The "seafood deficit" threatens our "food security."* Right out of Orwell, the Bush Administration is playing the terrorist card by raising fears that we might go hungry if we do not build fish farms in the ocean. NOAA has traveled the globe from

Ireland to Seattle to the Philippines presenting their top level analysts' and department heads' view that mariculture is both inevitable and safe. Besides the disingenuousness of those positions, their statements that mariculture is needed because of a supposed "seafood deficit" that threatens our food security is especially manipulative.

Seafood is second to oil in the "natural resources" subcategory of all of the items that we ship in and out of the U.S. at a deficit, but hardly second in all categories. In addition, since the ocean fish farms have a significant potential of diminishing or destroying wild fish, ocean fish farming could, in fact, increase the seafood deficit. NOAA would like to talk about the seafood that we import while ignoring the seafood that we export. NOAA simply ignores the option of increasing U.S. seafood exports as a way of decreasing the "seafood deficit" because that option would require greater protection of our lands, waters and oceans. Finally, the U.S. produces far more food than it needs or imports, thus operating as a net world food exporter. Any contention that we need mariculture to have national "food security" is therefore pure myth at best and exaggeration at its worst.

Many would argue that NOAA is a large part of why there is a seafood deficit. It was that agency that pushed for and assisted in expanding the commercial fishing fleet in the 1970s well beyond its known sustainable level for many species. In fact, some of the same bureaucrats that over-sold expanding the commercial fleet to take advantage of the then newly recognized EEZ are now salespeople for growing mariculture. It seems many of those who began their careers in NOAA, and are now in senior positions, have learned little from history.

2. *"Escapes are way down."* The vast majority of mariculture facilities in North America are in British Columbia, at least 130 at last count. Those farms are required to report escapes and it is true that the escapes reported by the farming industry have decreased over the last few years. However, a statistical reduction of escapes is an inexcusable rationalization because these invasive species are still invading otherwise natural areas. As indicated above, in Scotland, over a million farmed salmon escaped in January 2004, following the storm damage done to netpens there and over a million farmed salmon escaped in July 2004 from farms in Chile due to severe storms. During the 2004 hurricanes in the Gulf of Mexico, six oil platforms collapsed and several more suffered severe damage, while many more than that were destroyed as a result of the 2005 hurricanes. These are the same platforms that are being proposed for staging areas for mariculture facilities. Since the purported reduction, in addition, is via numbers reported by the industry, its accuracy is also suspect.

3. *"Better monitoring of feed and better feed systems have greatly reduced pollution from sewage (uneaten feed)."* There may be better monitoring of feed and better feed systems, but feed is only a percentage of the total pollutant entering the ocean. Reducing the amount of a pollutant, moreover, is still no excuse for dumping the pollutant in the first place.

4. *"Sewage from experimental projects is barely measurable."* It is not easy to obtain all necessary information about how these experimental projects are operated; however, the stocking densities are very important to the sewage generated. (Those densities are also very important to the spread and eradication of disease.) Sewage measurements without all of the information about how the measurements were done and what the stocking densities were are useless. One recent study found that NOAA's goal of a $5 billion ocean fish farming industry would add sewage to the ocean equivalent to that of 17 million people.

5. *"It is too expensive to build a closed containment system on land."* The startup costs associated with land based production are higher, but the production costs are lower, and eventually the startup costs are amortized. It is true that larger capital requirements make it difficult to compete on price with lower cost operations. The money NOAA is investing in ocean fish farming, however, would be better spent supporting land based operations and differentiation of the land-based product as "eco-friendly" or "sustainable" would encourage more closed land-based systems.

6. *"Wild fish will eat fish anyway."* This argument is the most insidious in that it presumes that it's OK to interfere with a natural system just because we can. The ocean ecosystem is complex and varied. Removing a majority of its small fish will deprive the fish that depend on them their food source. Removing those small fish will also cause the even smaller creatures to lose their natural predators, causing them to multiply beyond their healthy numbers. The consequences are largely unknown but potentially disastrous. Our attempts to modify the ocean ecosystem should be minimized, not maximized.

NOAA's NOAA Bill Lacks Provisions Essential To Safeguard Marine Fisheries And Ecosystems Along With Protections For The Use Of A Public Resource

The Administration claims that this bill is "to provide the regulatory framework for the development of aquaculture in the United States Exclusive Economic Zone (EEZ)," the area three to 200 miles offshore. Unfortunately, the bill contains no environmental protections or standards specific to fish farms, gives away the right to use the public's land (use of the seabed and the waters above) to private entities and allows all of this to be done in secrecy. Without these protections, massive offshore aquaculture development would threaten ocean fisheries in a number of ways and we must oppose the bill as now drafted.[2]

The Administration is touting this legislation as the centerpiece of the President's "Ocean Action Plan" developed last year in response to the U.S. Commission on Ocean Policy recommendations. Three amendments were immediately made to it by the bills own authors, and a fourth was introduced by the authors and Senator Olympia Snowe (R–ME). Among the amendments introduced by Senators Stevens and Inouye is one to allow coastal states to decide whether or not they even want offshore aquaculture in the EEZ off that state's coastline.

The bill contains serious problems apparent to anyone concerned about wild fish stocks and the ocean environment. Even the title is problematic, since it has the same acronym as the implementing agency, the National Oceanic and Atmospheric Administration (NOAA), indicative either of a lack of thought or someone's attempt at being cute. Imagine NOAA implementing "NOAA."[3]

Findings

The first major section called "findings" contains statements that highlight just how biased toward fish farming the bill really is. It states that it is the policy of the U.S., for example, to support "an offshore aquaculture industry that will produce food and other valuable products, protect wild stocks and the quality of marine ecosystems, and be compatible with other uses of the Exclusive Economic Zone." Yet the pollution generated by these ocean-based feed lots along with the damage caused by escaping non-native fish in conjunction with the net loss of protein due to feeding requirements means that the farms would actually threaten wild stocks and the ocean ecosystem. The bias of the bill is shown by the fact that it ignores the damage done by the activity that it is itself encouraging.

The bias of the bill is also evident in a finding that expresses a desire for a permitting system "to encourage private investment," but with no mention of the permitting system's potentially positive environmental protection aspects. Most Federal environmental statutes contain a policy statement that encourages the industrial conduct while reciting the need for protecting the environment from the effects of that industrial conduct. The findings in this bill do not even give lip service to using the permitting system to protect the marine environment.

This is especially troublesome because the lack of any policy to protect the ecosystem could be interpreted as a decision by Congress to give preference to fish farms over ecosystem protection in all cases of conflict. It could be argued that by not including a "balancing approach" in the bill, but by including balancing approaches in other statutes, Congress was making a clear choice to open up the EEZ to fish farming without regard to the ecological consequences.[4]

Site Permitting Ocean Fish Farms

Section 4 is the heart of the bill in that it sets up the procedures for the two permits that a farmer will need to obtain: a site permit and an operating permit. Section 4 is divided into the following subsections: (a) general provisions (with eight subdivisions); (b) site permits (with four subdivisions); (c) operating permits (with two subdivisions); (d) criteria for issuing permits (with six subdivisions); (e) exclusion from provisions of Magnuson-Stevens (with four subdivisions); (f) fees and other payments (with three subdivisions); (g) authority to modify or suspend permits (with

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[2] Along with introduction of the bill, NOAA issued a document titled *Section-By-Section Analysis, National Offshore Aquaculture Act of 2005* ("NOAA's Analysis"), available at: *www.nmfs.noaa.gov/mediacenter/aquaculture* along with other Administration documents on the bill.

[3] Please note that the Secretary of Commerce, the Secretary and NOAA may be used interchangeably throughout this letter.

[4] By a comparison, the Magnuson-Stevens Act requires a balancing of several interests and leaves the outcome of that balancing to the individual fisheries councils, while the Marine Mammal Protection Act (MMPA) explicitly prohibits the intentional taking of marine mammals without any balancing. Lack of any balancing language makes this finding section potentially a very dangerous portion of the bill.

two subdivisions); (h) actions affecting the outer continental shelf (with four subdivisions); and, (i) transferability of permits.

The general provisions authorize the Secretary of Commerce "to establish . . . a process to make areas of the [EEZ] available . . . for the development" of ocean fish farming by setting up the permitting procedures. That permitting process must include: (A) "development of procedures necessary to implement" the process; and (B) "coordination of the offshore aquaculture permitting process . . . with similar activities administered by other Federal agencies and States."

Authorizing the Secretary to "establish a process to make areas of the [EEZ] available . . . for the development" of ocean fish farming is, like some of the statements in the "findings" section, another sign of the explicit bias built into the bill. There is no attempt to make it look like a balancing approach with any reference to environmental protection. *There is no standard by which to judge the point at which open ocean aquaculture should not be developed; only that it is to be developed.*

The second part of this subdivision is especially confusing and subject to two differing interpretations. It could be interpreted as allowing NOAA to set up a coordination procedure that is required to be followed by all Federal and state agencies with permitting authority. It could also be interpreted as allowing NOAA to set up a coordination procedure that might be followed by those same agencies. NOAA's Analysis describes this by stating that "[c]oordination with other Federal agencies and States is an important element of the regulatory system established in this Act." This provision is worthy of note for three reasons:

- It vests sole authority in the Secretary of Commerce to develop the rules governing this coordination, as opposed to other possibilities such a committee from the relevant agencies setting the rules or Congress laying out the rules. By granting that authority solely to one department, the bill allows Commerce (under the first interpretation) to make rules that govern other departments, such as the EPA, Army Corps of Engineers and Department of the Interior.
- It also leaves the permitting authority with the original agency, as opposed to allowing NOAA to issue permits on those other agencies behalf.
- This coordination provision, finally, brings in States' efforts to address ocean fish farming facilities by bringing them into the coordination rules.

The bill also adds an additional permit where the permit application is for a farm on or within one mile of a permit issued under the Outer Continental Shelf Lands Act (OCSLA). In those situations, the additional permit requires the "concurrence of the Secretary of the Interior." This formally acknowledges that ocean fish farming immediately off of or near a drilling platform could be allowed.

Subdivision (a)(4) of Section 4 requires that a permit holder must be an U.S. resident or other U.S. organized business entity. This requirement can be waived (under certain conditions not relevant here), thus allowing non-citizens and foreign corporations to hold ocean fish farming permits. On the same day that Senators Stevens and Inouye introduced the bill they also introduced an amendment that removed the waiver provisions. It may be that this is a distinction without difference since a foreign corporation could simply set up a U.S.-based shell corporation to qualify.

The bill provides that site and operating permits may be submitted and reviewed at the same time. While it may be hard to argue with this "good government" provision, it does have the effect of speeding up the process and of lumping the site considerations together with the operating aspects of any particular project. This is in contrast to the proposed California system that requires appropriate sites be inventoried before specific operations are considered.

The Secretary must also rule on a permit application within 120 days of completion of all applicable statutory and regulatory requirements. Extra time is allowed at NOAA's request (but not at the public's), under certain circumstances. Requiring a ruling on permit applications within 120 days is solely for the protection of the fish farmers by protecting them from regulation by delay. NOAA's Analysis indicates that this 120-day requirement is "needed to ensure an efficient permitting process in which applicants receive decisions on proposed operations within a reasonable timeframe." This, of course, only highlights the bias of the bill by the failure to acknowledge the time needed to prepare a response to any application.

Several provisions of the bill confirm that the bill does not supersede other Federal laws and regulations (except the Magnuson-Stevens Act, as discussed below). Under the preemption doctrine, however, state law applies unless it is in conflict with Federal law. Thus, for example, a state ban on salmon farming would still apply in state waters, but since the Federal fish farming bill allows salmon farming in Federal waters the state ban would have no effect on Federal actions in Federal

waters. State laws protecting their offshore resources thus become irrelevant outside state territorial waters.

The subsections that address site and operating permits give the Secretary total discretion regarding the permits terms, conditions and restrictions. The only requirement for a site permit is that it must specify "the duration, size and location of the [fish farming facility]." The operating permit must additionally indicate the species to be raised. Thus, the Secretary is given the legislative equivalent of *carte blanche* regarding the site and operation permit conditions, except for the few obvious and non-controversial details listed just above. This is one place in the bill where standards might be placed, but the only standards are incorporated by reference. Those references to environmental protection are: (1) in the incorporation of pre-existing environmental law; (2) in the "Criteria" section (Section 4(d), discussed just below), and; (3) in the Environmental Requirements section (Section 5, discussed below).

The site permit subsection also compels the permits to have a duration of 10 years and be renewable in 5-year increments. The duration of permits for facilities that are also covered by a lease issued under the OCSLA (e.g., offshore drilling platforms) is determined by the Secretary of Commerce in consultation with the Secretary of the Interior. Leases for "demonstration projects" are also not included in the 10-year/5-year requirements and could go on indefinitely.

Elsewhere in the bill, the Secretary of the Interior is given authority to enforce lease, permit and OCSLA requirements and to issue emergency orders over fish farming that occurs on or within one mile of drilling platforms. This again confirms the possibility that fish farms will be authorized at or near a producing oil or gas drilling platform. It also repeats earlier provisions that grant Interior some concurrent authority over fish farms on and near these platforms.

The site permit subsection also compels holders of a site permit to "remove all structures, gear, and other property from the site as may be prescribed by the Secretary" when the permit term is complete. As a part of those removal provisions, should a fish farmer not be able to remove the farming facilities from a drilling platform, the owner of the platform could be responsible for those costs. This subsection also provides further confirmation that fish farms are contemplated on and near drilling platforms.

Issuing Ocean Farming Operational Permits

Section 4(d) is entitled Criteria for Issuing Permits. This subsection requires the Secretary to "consult as appropriate with other Federal agencies to ensure that" a permitted ocean fish farm "meets the environmental requirements established under section 5(a) and is compatible with the use of the Exclusive Economic Zone for navigation, fishing, resource protection, recreation, national defense (including military readiness), mineral exploration and development, and other activities." Unfortunately, this provision borders on meaningless for ensuring any protection of the marine environment.

The first requirement, that ocean fish farming only meet the very minimal environmental requirements of Section 5 of the bill will be discussed below. This "criteria" subsection, moreover, only requires that NOAA "consult as appropriate" with other agencies to insure compatibility with the other listed uses, not that it actually protect other listed uses. As a part of that consultation, fishing and resource protections are accorded the same weight, if any, as navigation, recreation, national defense, mineral exploration and development, and "other activities."

A second part of this "criteria" subdivision compels the Secretary to "consider risks to and impacts on natural fish stocks, the coastal environment, water quality and habitat, marine mammals and endangered species, and the environment, as identified by the Secretary and other Federal agencies." Again, *risk and impact consideration is the only thing required here. Once those risks and impacts are considered, the Secretary is still free to ignore them.* This consideration requirement adds no protections that are not already required by the National Environmental Policy Act (NEPA). There is no requirement that those risks be minimized or balanced against other aspects of an ocean fish farm. There is also no requirement that the process of that consideration be public. These "criteria for issuing permits," therefore, do nothing to assure any ecosystem protections.

The final subdivision under 4(d) requires NOAA to "periodically" review the criteria for permits and to modify them "based on the best available science." This is also such a vague standard as to make it unenforceable and meaningless. "Periodically" and "best available science" are so vague that the subdivision essentially gives complete discretion to NOAA. The language, moreover, does not compel NOAA to change the criteria based on that review.

Subsection 4(e) excludes the permitting system set up under this bill from the Magnuson-Stevens Act. Whether permits under this bill should be governed by the Magnuson-Stevens Act and its regional councils may be subject to debate and full discussion of that issue is beyond the scope of this article. Some of the points to consider, however, are that Magnuson-Stevens, at least, require some balancing of competing interests and transparency of the process. This bill does neither.

The bill also requires that the Secretary consult with the local Regional Fishery Management Council prior to issuing a permit. Requiring consultation may be a positive step, but without requiring that action be taken based on that consultation or, better yet, requiring that the regional council also permit farming facilities, the consultation requirement is hollow.

Finally, this portion of the bill authorizes, but does not require, the Secretary to require ocean fish farmers to "track, mark, or otherwise identify" the farms' product. Tagging farmed fish should be required.

Not Paying Their Way

A "Fees and Other Payments" subsection authorizes the Secretary to set application and permit fees and to waive those fees for research or hatchery facilities. The Secretary is also required to demand a bond to insure payment of unpaid fees, the cost of removing the farming facilities at the end of the permit period, "and other financial risks as identified by the Secretary." The worst part of this section is that there is no requirement for royalty payments for use of a common public resource.

Most statutory schemes that allow extraction of a public resource also require some sort of a lease or royalty payment to the government. Oil, gas and coal extraction, for example, requires a royalty, while grazing requires a lease payment. These are paid to the Federal Government to help compensate for the value lost to the public and/or for the damage that the activity does to the environment.

This bill, on the other hand, gives away large plots of ocean to private corporations, without requiring either royalty payments or a compensating high level of employment/economic benefit to coastal communities. Adding a lease or royalty payment requirement would be the fair thing to do because: (1) it would be consistent with most other Federal laws; (2) it would more fully internalize the true environmental costs of the operation; and (3) it would compensate the public for the loss of a public resource.

This fee subsection, moreover, also has no requirement that fees even cover the costs of reviewing permit applications or enforcement duties, and is totally discretionary. The bond (as opposed to the fee) requirement is limited to insuring payment of unpaid fees, the cost of removing the facility at the end of the permit period, "and other financial risks as identified by the Secretary." Lacking is a requirement for the bond to cover clean-up costs, damage done by escapes, and damage done by the spread of farm-based disease. Finally, the provision that allows for waiver of fees for research or hatchery facilities should be limited to facilities that are not showing any monetary profit.

The Secretary is also given broad discretion in the bill to modify or suspend the permits. This power is subject to "consultation with Federal agencies as appropriate and after affording the permit holder notice and opportunity to be heard" unless an emergency situation. This subdivision lists some of the factors that can be considered, but compels nothing other than reasonable notice to and right to be heard by the fish farmer. In another sign of the bill's bias, these provisions omit notice to the public when considering modification of a permit and contain no attempt to conform modification requirements to requirements of original permits.

The final subsection addresses the transferability of permits by making them fully transferable subject to procedures established by NOAA. There is nothing that prevents NOAA from allowing transfer to a less solvent corporation or a foreign corporation, nor to prevent consolidation of fish farms under the ownership of a few or single corporations.

Section 5: Few Environmental Requirements

Section 5, in spite of its promising title, contains little actual environmental protection. The single requirement of Section 5 is to "*consult* with other Federal agencies and identify the environmental requirements applicable to [ocean fish farming] under existing laws and regulations." In other words, they are compelled merely to follow the laws they were already compelled to follow before.

The Secretary is allowed under Section 5 to "establish additional environmental requirements" for ocean fish farming "if deemed necessary." These additional requirements, if any, are to be made in consultation with other Federal agencies, coastal states and the public. The environmental requirements under this section shall *consider risks and impacts* on "natural fish stock", "marine ecosystems," var-

ious features of "water quality and habitat," "marine wildlife and endangered species," and "other features of the environment."

The second part of Section 5 allows, but does not compel, "regulations regarding monitoring and evaluation of compliance with" permit requirements. Also authorized, but not compelled, is monitoring of the effects of ocean fish farming and of compliance with the "environmental requirements."

In other words, though this section contains a number of phrases that sound like environmental protection, *being only advisory they have no force.* As in other parts of this bill, this "consideration" requirement adds no protections that are not already generally required by NEPA and other laws.

In general, the bill completely ignores the fact that ocean fish farming presents a set of known risks to the environment and to fish stocks that should be addressed. While not perfect, the current version of the pending California fish farming bill, for example, requires, among other things, that: the use of fish meal and fish oil be minimized; fees be sufficient to pay for the costs of administering the permitting program, and for monitoring and enforcing the terms of the leases; a baseline assessment be done along with regular monitoring of fish stocks and facilities; drugs and antibiotics usage should be minimized and reported; and all farmed fish be tagged. The Federal bill contains none of these protections.

The *Environmental Requirements* of Section 5 and the total discretion it, along with Section 4, gives to the Secretary also completely ignore NOAA's own past policy statements. The National Marine Fisheries Service (NMFS) (now pompously calling itself "NOAA Fisheries") has previously developed *A Code of Conduct for Responsible Aquaculture Development in the U.S. Exclusive Economic Zone* (*www.nmfs.noaa.gov/trade/AQ/AQCode.pdf*). That Code calls for use of best management practices and site evaluation consideration of effects on local communities, adoption of the precautionary approach, escape prevention, inventory tracking systems, and predator protection.

While these statements do not go nearly far enough, it is outrageous that NOAA is ignoring even its own weak standards in the legislation that it designed and is now aggressively promoting.

Administration

Administration of offshore aquaculture is found in Section 7 of the bill, which has eight subsections. The first authorizes the Secretary to promulgate rules to carry out the bill and to amend those rules as need be. The next authorizes the Secretary to promulgate rules to "protect marine aquaculture facilities," and to request the Coast Guard to "establish navigational safety zones around such facilities." The "Secretary of the department in which the Coast Guard is operating" may also designate a navigational safety zone that excludes other uses.

Subsections 7(c) and 7(d) require the Secretary to "consult" with other Federal agencies with permitting authority in the EEZ to develop a coordinated and streamlined permitting process for ocean fish farming. Problems with the permit coordination provisions are discussed above. Neither the Section 4 permits nor the Section 7 coordination provisions supersede or substitute for any of the other permits currently required by law for a fish farming facility; e.g., section 10 permits from the Corps, CWA permits from EPA, and incidental take permits under the MMPA and ESA. In other words, they do not shift other permit reviews from EPA, for example, to NOAA.

There does appear to be a conflict between the Section 4 and the Section 7 coordination provisions. The Section 7 coordination provisions are not mandatory while the Section 4 coordination provisions, while vague, seem to allow NOAA to set-up a required coordination process. Section 7 only requires that the Secretary "consult" with the other agencies "to develop" the streamlined process. The Section 4 provision, however, authorizes NOAA to establish a process for development of fish farming in the EEZ that includes the coordination of the permitting process "with similar activities administered by other Federal agencies and States."

What's Not in the Bill

Transparency: This bill does not address any issues of transparency and the extent that other statutes like the Administrative Procedures Act may require public notice of things like permit applications or disclosure of documentation. Moreover, because ocean fish farming under this legislation would be exempt from the Magnuson-Stevens Act, the public process provided under that Act for the conservation and management of capture fisheries would not be available for ocean fish farming. The *NMFS Code of Conduct,* however, does encourage public participation.

Private Attorney General Actions: Almost all Federal environmental statutes contain provisions for private suits against those in violation of the statute, including

alleged permit violators. The purpose of those provisions is to allow individual groups to help police the statute, especially when the government does not act or does not act fast enough. Since this bill contains no such provisions, only the Federal Government would be left to enforce the Act. Thus fishing and conservation groups or the public would be precluded from suing the Secretary for any violation under this Act.

Liability: This bill contains no provisions regarding who is liable for escaped fish. As a general rule, the negligent owner of escaped private livestock is responsible for the damage done by that escaped livestock. If sheep escape through a negligently maintained fence and eat a neighbor's lettuce crop, for example, the owner of the fence is liable for the value of the lost lettuce crop. However, proof that escaped farmed stock did any alleged damage could be difficult, if not impossible, depending on the type of farmed fish, the location and the damage. Section 4(e)(4) authorizes, but does not require, the Secretary to require farmers to "track, mark, or otherwise identify" the farms' product. This should be a requirement.

Conclusion: A Seriously Flawed Bill

NOAA's ocean fish farming bill does not exempt those farms from NEPA, CWA, CZMA or any other Federal environmental statutes other than the Magnuson-Stevens Act. Other than that, however, it ensures no environmental protection from the effects of ocean fish farming because it gives the Secretary of Commerce nearly complete discretion to manage them as s/he sees fit, regardless of the environmental consequences.

What few environmental standards exist in the bill are either optional or have to do only with "consultation" on and "consideration" of environmental issues, but with no objective or mandatory targets to meet, and no attempt to balance one interest against damage to the others. In short, the bill as it now exists is seriously flawed and would open the road to further disaster for the ocean.

PREPARED STATEMENT OF DR. DANIEL BENETTI, CHAIRMAN, DIVISION OF MARINE AFFAIRS AND POLICY, ASSOC. PROFESSOR AND DIRECTOR OF AQUACULTURE, UNIVERSITY OF MIAMI ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE (UM–RSMAS)

Besides my research and academic responsibilities at UM, I am in charge of R&D and technology transfer projects for the development of sustainable aquaculture worldwide. I have over 25 years experience in this field and have published close to a hundred articles in aquaculture science and technology. I have extensive experience with the industry and outreach, and have been a consultant for the government and private sectors in the U.S., Latin America, Europe, Asia, Caribbean, Middle East, Africa, and Australia.

As a team leader working "on the ground" of a major interdisciplinary, multi-institutional effort to demonstrate the technological feasibility of offshore aquaculture in the SE U.S. and Caribbean regions, I would like to provide a few comments in rebuttal of criticisms and in support of the National Offshore Aquaculture Act of 2005. The following are my direct, no-nonsense views on some of the issues at stake. These comments represent my opinions, and do not necessarily represent the opinions of the University of Miami or any of its schools.

User conflicts and pollution concerns suggest that major environmental benefits are to be gained by moving cage aquaculture operations further offshore. The U.S. is paving the technological road to sustainable development of offshore aquaculture through university-industry-government partnerships. Emerging technology, in collaboration with the private sector, is being used to demonstrate the environmental sustainability and economic viability of raising hatchery-reared fish in submerged cages in exposed sites in the U.S., notably in Hawaii, Puerto Rico and New Hampshire.

Critics say that there are no environmental safeguards in place for obtaining permits for open ocean aquaculture in the U.S. because they never applied for one. During our permit application for the development of one such project in Puerto Rico in 2001, we had to fulfill the requirements of 13 agencies (including EPA, ACE, NOAA, FWS, among others)—each one competently justifying its existence. When applying for the permits for the expansion of the project in 2005, the list of agencies involved increased to over twenty. (A list of agencies involved in the permitting process is available upon request). The permitting process is complex, lengthy and expensive, requiring a great deal of scientific and legal expertise. Prospect applicants are advised not to even try applying for a permit if they don't have the expertise and cannot afford waiting several years and spending hundreds of thousands

of dollars. The Offshore Aquaculture Act proposes to organize the permitting process with NOAA as the leading agency centralizing the application. This is clearly the right and sensible path to follow.

The offshore aquaculture demonstration projects currently being conducted in Puerto Rico, Hawaii, New Hampshire and the Bahamas are completely submerged, thereby preserving the aesthetic appearance of the areas. Systems clear at least 12m from the surface in order to avoid impediments with navigation. The depth of the sites (25–30m) and steady currents (0.5–1.5 knots) maintain water movement in a downstream direction, dispersing organic and inorganic materials that could potentially be associated with the operations. Considering the cages' volume and the current velocity, approximately 2 billion liters of clean oceanic water flow through each cage daily. The cages are stocked with hatchery-reared fingerlings of endemic, native species such as cobia, snapper, amberjack, moi and cod—species whose fisheries are mostly depleted. We have enough data to show that the nutrients and suspended solids generated by the cage systems would not dramatically affect the oligotrophic offshore environment due to its carrying capacity. This premise is important because of previous indications that inshore cage culture of marine finfish may be detrimental to coastal waters due to excessive nutrient loading, hypernutriphication and euthrophication with subsequent harmful algal blooms. Please note that we have data, reports and publications to support these assertions.

Environmental monitoring studies are being conducted in all demonstration projects in the U.S. (Puerto Rico, Hawaii and New Hampshire) and the Bahamas to determine whether there is or will be an impact of such activities in the areas surrounding the cages. I have been coordinating the assessments conducted by the University of Miami and the University of Puerto Rico in the areas surrounding the cages in both Puerto Rico and the Bahamas. In summary, over the last 4 years, sampling stations were set up at different distances and directions from the fish cages. Possible eutrophication of the local environment was evaluated monthly by measuring dissolved nitrogen and phosphorus, phytoplankton biomass, epiphyte growth potential, sinking flux of organic matter into sediment traps, organic content of the sediments, and benthic microalgal biomass. In all cases, *no significant differences* were found as a function of distance from the cages or relative to upstream-downstream direction. Environmental data from Puerto Rico and the Bahamas indicate that the current regime and resulting dilution of nutrients from the submerged cages do not lead to a significant change in the ecosystem near the cages. There were no significant differences in any of the water quality parameters measured in the area surrounding and beneath the cages, indicating that fluctuations appeared to be seasonal, affecting the cage and control site more or less equally. These findings are relevant because elevated nutrient concentrations are usually only found once the assimilation capacity of the autotrophic community has been exceeded or when large nutrient imbalances exist. The final reports of the first 2 years of studies on the environmental impact of the offshore cages in Puerto Rico and the Bahamas are available upon request. Similar findings resulted from the environmental assessments conducted in Hawaii and New Hampshire.

Also importantly, taking into account that energy loss between trophic levels in nature results in an ecological efficiency of only around 10 percent, our data show that practicing aquaculture as a means to produce high-value fish for human consumption is more efficient than this transformation in nature. Nevertheless, the need to reduce and perhaps eliminate the use of fishmeal in aquaculture feeds is widely recognized. Research in this area progresses fast, and we aquaculture scientists are making a strong effort toward this goal. Our research indicates that, when relying on fishmeal from sustainable fishery resources and properly sited and managed facilities, aquaculture of carnivorous fish can be conducted responsibly. However, the efficiency of fishmeal use in the culture of carnivorous fish as it relates to long-term sustainability is a complex issue. It is dependent on the management of small pelagic fisheries, which in turn depends on fishing pressure, oceanographic and meteorological parameters, as well as long-term climate changes and anthropogenic factors.

There are still many hurdles to overcome before open ocean aquafarms can become economically viable. Indeed, high risks associated with offshore operations may conspire against their economic viability. When we began developing these projects, our primary concern was with the environmental impact that the cages could potentially cause in the surrounding areas. Our focus and attention have shifted to the economic viability of the operations, since the first 4 years of studies did not show any harmful effects on the environment. Regarding this matter, there have been fish escapements and production losses, compromising the economic viability of the operations. Even though these fish are native to the region, and healthy, disease-free, some scientists and environmentalists believe that such escapements

could compromise the genetic makeup of the local population of the species. This nonsensical claim—the equivalent of denying human immigration on ethnic grounds—does not *fly* with an immigrant who has made a productive life in this country, like many of you or your ancestors did before me. After all, diversity is one of the main reasons for the greatness of this country.

Some environmentalists are quick to criticize what they hear and read about what a handful of U.S. entrepreneurs are doing to develop a new, environmentally sustainable and economically-viable industry that will help alleviate our dependency on seafood imports and reduce an escalating trade deficit currently at almost $10 billion/year. The world is not waiting for us. Taking into consideration current global trends, it is certain that we need to develop aquaculture.

The offshore areas of the U.S., its Islands and Territories have extraordinary potential for the development of an environmentally sustainable offshore aquaculture industry. We at the U.S. are ahead of the world in technology for open ocean aquaculture and cannot afford losing the edge as we are already doing in other fields. American entrepreneurs and venture capitalists are interested in investing in the industry but—in light of the negative perception that the environmentalists are selling to the public—are already beginning to look abroad. We must simplify the process and move ahead with this legislation so as to keep the industry within our control—and the National Offshore Aquaculture Act is the first step toward U.S. autonomy in seafood supply.

We have created the opportunity in the U.S. and must capitalize on it. Moving the industry offshore is the right path to the development of a low impact, high yield industry that will produce most needed seafood while creating jobs and other socio-economic benefits. Beyond economics, the importance of developing the offshore aquaculture industry in the U.S. EEZ may become a matter of national food security soon. We cannot afford *not* to do it. Indeed, not allowing offshore aquaculture to develop in the U.S. would be the equivalent of having used the precautionary approach for not having allowed the wine and the computer industries to develop in California because of potential, unsubstantiated environmental risks. Plain nonsense.

PREPARED STATEMENT OF DONALD B. KENT, PRESIDENT,
HUBBS-SEAWORLD RESEARCH INSTITUTE (HSWRI)

The Hubbs-SeaWorld Research Institute (HSWRI) has conducted marine aquaculture and fisheries research for the past 30 years. We offer the following comments on the proposed Offshore Aquaculture bill that has been introduced by Senator Stevens and Senator Inouye.

Your Subcommittee is already aware of the significant trade deficit caused by our Nation's dependence on imported seafood needed to feed its citizens. Many of our fisheries are already fully exploited and cannot meet the anticipated doubling of demand that our Nation will require over the next several decades. This increased demand can only be met with the development of aquaculture. As Jacques Cousteau said in 1973, "we must farm the sea as we farm the land, by sowing as well as reaping."

HSWRI, working in collaboration with the California Department of Fish and Game, commercial fishermen, recreational anglers and the National Marine Fisheries Service, conducts the Nation's largest marine finfish replenishment program. This program has afforded us the opportunity to test already established, commercial-scale, open-ocean technologies on species of regional importance to the Southwest. This technology can be applied to any region of our Nation to culture native species of economic importance to that region, and is already being applied around the world. I believe it is critical for our Nation to incorporate this technology into the development of a consistent, domestic supply of seafood from aquaculture.

The proposed legislation would establish a standardized process by which aquaculture could be developed in an ecologically appropriate and sustainable manner. Our Institute has consistently demonstrated how this can be done by working in concert with fishermen, anglers and regulatory agencies and in a manner that decreases the pressure placed on our already heavily exploited wild fish stocks. We would welcome the opportunity to share with you the results of our research and to answer your questions regarding the development of aquaculture in our Nation's Exclusive Economic Zone.

PREPARED STATEMENT OF MARIANNE CUFONE, ESQ., ENVIRONMENTAL ATTORNEY AND ADVOCATE, ENVIRONMENT MATTERS

My name is Marianne Cufone, I am an environmental attorney and advocate in Tampa, Florida. I work with a number of groups and individuals on offshore aquaculture issues throughout the United States and I am very involved in the Gulf of Mexico region with fishermen, consumer and conservation organizations, academics, government agencies and others. I am the Vice Chair of the Gulf of Mexico Fishery Management Council Offshore Aquaculture Advisory Panel and a member of the State of Florida Aquaculture Task Force. These bodies are tasked with helping to develop local and regional regulations on open water aquaculture.

It is a privilege to submit the following for your review and consideration.

There are many concerns about development of offshore aquaculture, far more than I can cover in a few pages. I will therefore concentrate on the primary concerns that I and the various people I work with have regarding S. 1195. The first is pollution: both of wild fish populations and the environment. The second is user conflicts.

Pollution of wild fish populations is the intermixing of aquacultured fish with wild fish through escapes from cages and pens in open water. Offshore aquaculture of finfish currently uses a cage or pen to contain the fish. Some fish will escape from these containers into the open ocean from various complications like severe weather, predators tearing at netting, faulty equipment, human error and a number of other possibilities. Because these fish are captive and bred for profit they are often different from wild fish. They may be exotic species, from a different area entirely to introduce a new product to a local market. Aquacultured fish can mutate in captivity for unknown reasons, or because of inbreeding. Some fish behaviors are learned from natural communal interactions, so even unaltered captive fish can have different behaviors than wild fish and if released, the aquacultured fish can change natural behaviors in the wild. Perhaps most disturbing, fish used for aquaculture might be genetically modified in a lab to create faster growing and larger fish or might be continually selectively bred to achieve the same result. Escape of fish that are different from wild fish could change the ecosystem and natural fish populations permanently.

Pollution of the environment refers to wastes coming out of the aquaculture facility into our waters, like excess food, fish waste, parasites and other diseases, excessive algal growth, dislodged cage or other facility materials and antibiotics or other chemicals. These all can destroy important habitat, like corals and seagrass, even far from the facilities, carried by currents. Debris and wastes can contaminate our water and cause safety hazards for boaters, fishermen and divers and of course, harm wildlife.

Because offshore aquaculture facilities will take up real space in the marine environment, various user conflicts are expected between offshore aquaculture and other ocean uses. Contributing to this is the express provision in S. 1195 that allows creation of buffer zones around aquaculture areas in which no activities will be permitted other than those relative to the aquaculture facility. Some of the most likely and troubling conflicts are those regarding fishing grounds and routes to those fishing grounds, other vessel traffic lanes, military sites and areas of concern regarding national security, marine reserves and otherwise protected or vulnerable areas and areas of significant multiple use, for example boating, diving, and swimming. Essentially S. 1195 will re-allocate public resources for private gains without protecting existing uses.

Another area of significant conflict involves composition of aquacultured fish feed. Cultured species are often directly fed wild caught species or products that contain wild species. This is an inefficient use of the available natural protein resources. Lower trophic level species like krill, squid, and other small coastal pelagic fish are a crucial part of the marine ecosystem, serving as prey for marine mammals, birds and fish yet are still used to make captive fish feed. Many commercially and recreationally important fish species depend directly on the availability and abundance of such prey species for their survival and recovery. Prey species also support diverse marine mammal and seabird communities in the world including several species of endangered marine mammals and seabirds. In order to effectively protect and restore our natural ocean resources, it is critical to protect the health of prey species. Wild fish populations can only recover if the ecosystem upon which they depend is intact. Use of wild fish in creating feed for captive fish creates a very real problem for wild fisheries.

These are all serious issues nationwide, but particularly here in the Gulf of Mexico, many people are very concerned about expansion of offshore aquaculture. We are coastal people and are known for our commercial and recreational fisheries including shrimp, crab, lobster snapper, grouper and more. Tourism, based on our en-

vironment, is a key economic factor and so many of us live here to enjoy the benefits of a coastal lifestyle: relaxing on white sand beaches, swimming in clear blue waters, boating and every water sport imaginable. Also, the severe hurricanes of the past 2 years make us very vulnerable to any further alterations in our marine world.

I will provide one local example to illustrate regional concerns about pollution. It involves the use of oil rigs as sites for aquaculture facilities. This past year the Gulf of Mexico had several violent storms. A number of oil rigs were destroyed, some even being carried miles to shore. Had offshore aquaculture been developed on these rigs at the time of the storms, there would have been massive releases of captive fish, feed and other pollutants into the Gulf of Mexico.

Our region is taking steps to protect unique local resources because S. 1195 in its current form is insufficient to do so. The Gulf of Mexico Fishery Management Council has been developing an amendment to the fishery management plans for the Gulf of Mexico to regulate offshore aquaculture. I am the Vice Chair of their aquaculture advisory panel. Now, the draft regulations contain provisions to deal with many of the problems associated with offshore aquaculture. Things like preventing use of exotic or genetically modified fish, preventing use of antibiotics and certain chemicals, and requiring efficient waste management.

S. 1195 does not provide similar protections. Additionally, it removes real authority from fishery management councils to regulate offshore aquaculture, though they are in the best position to understand local needs. Under S. 1195, regional Councils would be demoted to a consulting or consenting role rather than a regulatory one.

In general, S. 1195 in its current form does not protect our resources or the people that rely on them and it is not an adequate means of regulating offshore aquaculture.

Specifically, I urge you to consider:

- Preventing use of areas like marine reserves, National Marine Sanctuaries and otherwise protected or vulnerable sites for aquaculture facilities.
- Establishing buffer zones around areas like marine reserves, National Marine Sanctuaries and otherwise protected or vulnerable sites to prevent potential harm from nearby offshore aquaculture facilities.
- Prohibiting the use of exotic species and genetically modified organisms.
- Specifying offshore aquaculture can only be developed over sand or mud bottom and in areas where effluent will not impact important and fragile resources.
- Establishing stringent environmental requirements before any permits are issued.
- Conditioning annual permit renewal on compliance with environmental performance.
- Requiring development and submittal of a plan to mitigate potential harms due to unexpected circumstances, including fish escapes, chemical pollution, illness and others, as a permit condition.
- Preventing use of oil rigs in offshore aquaculture.

I appreciate this opportunity to comment on the National Offshore Aquaculture Act, S. 1195, and I look forward to working with you and others on these important matters.

PREPARED STATEMENT OF GEORGE NARDI, CHIEF TECHNICAL OFFICER, GREATBAY AQUACULTURE, LLC

GreatBay is a young, but respected pioneer in the marine aquaculture field. We are a 10 year commercial operation and work closely with the University of New Hampshire and other research institutions around the country. In addition to domestic sales, our products are also exported to other countries such as China, Mexico and Canada. We operate in a global industry and must compete globally as well. We are looking to expand our production base in the region and a promising area for future sustainable development is in the offshore region of the U.S. EEZ. We have invested considerable resources in this investigation.

It is critical that this legislation is passed as many user conflicts will prevent us from developing this industry in populated near shore areas, and without this enabling legislation, opportunity will be lost—not for the industry, but for the region and the country, opportunity for new business development and jobs; opportunity for enhancing our national food security position. Industry will simply move forward, but to the benefit of another country.

Without this legislation GBA may have to pursue expansion, not just out of the region, but out of the country as the "price" to do business may become prohibitive and too complicated for innovative companies such as GreatBay Aquaculture.

I support the position of the National Aquaculture Association and hope you will support this important legislation, whose true value will be measured in the future production of quality protein for all to enjoy and benefit from.

PREPARED STATEMENT OF WENONAH HAUTER, EXECUTIVE DIRECTOR, FOOD & WATER WATCH

Food & Water Watch, a nonprofit consumer rights organization that challenges corporate control and abuse of our food supply and freshwater and ocean resources, wishes to thank you for the April 6th National Ocean Policy Study subcommittee hearing on offshore aquaculture. We are pleased to submit these comments for the record in order to highlight some of the issues surrounding offshore aquaculture that were not thoroughly examined at the hearing. We urge the subcommittee not to move forward on legislation to permit offshore aquaculture in the Exclusive Economic Zone (EEZ) until NOAA provides a detailed assessment of all the potential negative impacts of offshore aquaculture and ways these problems can best be addressed.

As detailed at the hearing, offshore aquaculture involves the raising of carnivorous finfish, such as cod, halibut, and red snapper, in often large, crowded cages where fish waste and chemicals flush straight into the open ocean. We are very concerned that offshore fish farming in the U.S. EEZ may pose many of the same problems for marine ecosystems, consumer health, and the economic livelihoods of fishing businesses and communities as large-scale industrial farming of carnivorous finfish has in other countries. While we were pleased that many of these issues were raised at the hearing, many of the issues about the likely effects of offshore aquaculture were not adequately examined at the hearing:

Dr. Hogarth did not provide any analysis of the likely individual and cumulative environmental and socioeconomic effects of offshore aquaculture due to, for example, chemical and nutrient pollution, escaped fish, or diseases and parasites transmitted to wild fish populations. Such impacts could negatively alter entire ocean ecosystems and harm fishing communities dependent on them.

Dr. Hogarth did not detail NOAA's plans, if any, to minimize the discharge of wastes and chemicals from offshore fish farms into the ocean environment. In the past, NOAA officials have argued that Clean Water Act discharge permits were sufficient. But under EPA's current regulations, such permits don't require limits in the use of pesticides or other chemicals. Further, EPA's regulations only require companies to maintain best management practices to reduce nutrient emissions, "to the extent reasonably necessary to sustain an optimal rate of fish growth"—regardless of the cumulative impacts of multiple farms. More information is needed on how best to limit wastes and why closed containment systems are not a better option for aquaculture than offshore cages.

While Dr. Hogarth indicated in his testimony that NOAA supports "careful mapping of existing uses" of the EEZ, he did not provide much detail about the agency's plans, if any, to engage in planning, zoning, or the development of siting criteria for offshore aquaculture. He also did not discuss whether NOAA plans to assess and maintain environmental carrying capacities of each region where offshore aquaculture is planned. All of these measures are recommended by a recent Sea-Grant-funded October 2005 University of Delaware report, "Recommendations for an Operational Framework for Offshore Aquaculture in U.S. Federal Waters."

Dr. Hogarth did not discuss whether NOAA would prohibit the siting of offshore fish farms in National Marine Sanctuaries or other protected areas. Nothing in S. 1195 currently prohibits such siting.

Dr. Hogarth did not discuss whether NOAA is opposed to prohibiting non-native or genetically modified species in offshore fish farms. There are no such prohibitions in S. 1195.

While Dr. Hogarth's testimony stated that "technological innovation, best management practices, and careful species selection" can limit fish escapes, he did not discuss whether NOAA would support requiring offshore aquaculture facilities to adopt these measures and, if so, the level of mitigation anticipated using different technologies and practices. He did not discuss whether offshore aquaculture facilities would be required to tag or track farmed fish or whether NOAA was opposed to such measures.

While Dr. Hogarth's testimony indicated that he believes that offshore aquaculture could benefit coastal communities, he did not provide a detailed analysis of

the likely impacts of offshore aquaculture on commercial fish prices and employment.

Dr. Hogarth did not discuss whether NOAA was planning to provide a Legislative Environmental Impact Statement (LEIS), which is required by the National Environmental Policy Act. An adequate LEIS would enable the subcommittee and the public to thoroughly evaluate all of the risks of offshore aquaculture, possible alternatives, measures that NOAA would recommend to mitigate these risks, and any unavoidable consequences of offshore aquaculture. Unfortunately, NOAA has thus far not produced an LEIS, despite the request from 16 members of the House of Representatives and repeated requests from conservation and fishing organizations.

These are only some of the most obvious issues that were not examined at the hearing. We urge the Subcommittee to not move forward on legislation to permit offshore aquaculture in the EEZ until NOAA adequately assesses all the potential problems of offshore aquaculture and how these can best be mitigated.

We would be happy to discuss our concerns further and look forward to working with you to protect our oceans and America's fisheries.

JOINT PREPARED STATEMENT OF JIM AYERS, VICE PRESIDENT AND MICHAEL F. HIRSCHFIELD, PH.D., VICE PRESIDENT, OCEANA

We appreciate your long-standing leadership on ocean conservation and management issues and urge you to continue that tradition by opposing the National Offshore Aquaculture Act (S. 1195), introduced at the request of the National Oceanic and Atmospheric Administration (NOAA). The upcoming Senate National Ocean Policy Study subcommittee hearing to examine current proposals to regulate offshore aquaculture will bring much needed attention to the potential threats offshore aquaculture poses to our marine resources. In contrast to S. 1195, the Natural Stock Conservation Act of 2005 (S. 796), introduced by Senator Murkowski, represents a much more progressive policy on offshore aquaculture that puts protecting our fisheries and the ocean environment that nurtures those resources first.

National Offshore Aquaculture Act (S. 1195)

The National Offshore Aquaculture Act (S. 1195) would expand aquaculture offshore without addressing the large environmental impacts that have become apparent from nearshore aquaculture operations. Both the U.S. Commission on Ocean Policy and the Pew Oceans Commission highlighted the real and significant problems that marine aquaculture, in general, poses to our marine resources and ecosystems. Risks to wild populations of fish include the spread of disease and parasites, the introduction of nonnative or genetically-modified species, interbreeding with farmed fish, competition for resources with escaped farmed fish, and increasing demand for forage fish to produce fish meal.

Other environmental impacts include pollution and harm to marine mammals. Many of the problems found with nearshore aquaculture operations, such as escapes, are likely to be magnified in the much rougher and less predictable offshore environment. In addition to environmental impacts, offshore aquaculture will likely impact fishing families by decreasing commercial fish prices with a flood of low-cost farmed fish—prices that are low only because the operations are not required to pay the true costs to the oceans. The environmental and socioeconomic problems of aquaculture need to be fully understood and solved before aquaculture is brought into our offshore waters, or we will be irresponsibly bringing known problems into new ocean areas.

We also oppose the State Opt-Out amendment (SA.769) to the National Offshore Aquaculture Act (S. 1195). If enacted, this amendment will bring a false sense of security from environmental impacts to states not participating in offshore aquaculture, and it does not address the potential socioeconomic impacts of aquaculture. For example, Alaska, a relatively remote state, would be threatened by the expansion of salmon aquaculture into the offshore waters of Washington. A few escaped fish carrying an exotic disease could infect and cripple Alaska's renowned salmon fisheries. In addition, there are already large economic impacts to Alaska's salmon fishermen from the flood of farmed raised fish in the market. Therefore, we ask you to also oppose the State Opt-Out amendment.

While we urge you to oppose the National Offshore Aquaculture Act (S. 1195) altogether, we also note that a Legislative Environmental Impact Statement (LEIS) is needed to accurately assess the environmental risks of S. 1195. A clear and unbiased assessment of those risks will allow members to make informed decisions about this legislation. The LEIS on S. 1195 could also be helpful in the consideration of standards to protect our fisheries and our ocean environment called for in the Nat-

ural Stock Conservation Act (S. 796). We ask you to request the National Oceanic and Atmospheric Administration to conduct a LEIS and a socioeconomic impacts study of S. 1195.

The Natural Stock Conservation Act of 2005 (S. 796)

Fortunately, a good solution is already available. With one modification, we support the Natural Stock Conservation Act of 2005 (S. 796). This bill, which prohibits offshore aquaculture until environmental and socioeconomic safeguards are established, would be strengthened by an amendment to include a ban on the use of genetically-modified organisms in aquaculture. Genetically-modified species may act like invasive species if introduced into the wild. They may be able to out-compete wild fish stocks, and interbreeding could ultimately modify the wild gene pool. With the inclusion of this ban, S. 796 is a forward thinking bill that makes sure the socioeconomic and environmental problems from aquaculture are addressed before aquaculture is expanded into offshore waters.

The risks of offshore aquaculture are too great to blindly stumble forward with an irresponsible piece of legislation. An amended Natural Stock Conservation Act (S. 796) with a ban on the use of genetically-modified organisms in aquaculture represents an opportunity for Congress to move forward with their eyes wide open. Please oppose the National Offshore Aquaculture Act (S. 1195) and the State Opt-Out amendment (SA.769) and push for enactment of an amended Natural Stock Conservation Act (S. 796).

PREPARED STATEMENT OF JOHN CONNELLY, PRESIDENT, NATIONAL FISHERIES INSTITUTE (NFI)

Chairman Sununu and Members of the Committee:

We appreciate the opportunity to submit a statement for the Committee record on the important issue of offshore aquaculture and the promising impacts that this developing technology could have on the U.S. seafood industry and the American families who depend on fish and seafood as part of a healthy diet and lifestyle.

The National Fisheries Institute (NFI) is the Nation's leading advocacy organization for the seafood industry. Its member companies represent every element of the industry from commercial boat owners to national seafood restaurant chains. NFI and its members are committed to sustainable management of our oceans and being stewards of our environment. We endorse the United Nations' Principles for Responsible Fisheries, and our members conduct their business in ways that can feed Americans now and in the future. Our members value our surrounding ecosystems and native species. Our investment in our oceans today will provide our children and future generations the health benefits of a plentiful supply of fish and seafood tomorrow.

Mr. Chairman, what might have appeared in a Jules Verne novel is coming true. The story of fish farms far off the coast and deep in the ocean is no longer the stuff of science fiction; it is becoming reality. But until it becomes reality for companies in the United States, Americans will miss out on this potential boon to our economy.

The Senate has pending before it now one of the key outcomes of last year's U.S. Oceans Action Plan: a proposal to establish the regulatory infrastructure for a national offshore aquaculture program. S. 1195, the National Offshore Aquaculture Act, would create a framework for the Department of Commerce to issue permits for offshore aquaculture. This legislation would streamline the permitting process and allow permits to be granted to build fish farms in certain geographic areas and for certain types of fish. The permits would be renewable. Finally, the permitting process would take into the account the views of states, other Federal agencies, and other impacted parties (such as fishing vessels operators and off shore oil drilling companies).

A number of nations are already engaged in offshore aquaculture. This kind of cutting-edge technology will become essential to meet the ever-growing demand for seafood around the world. The U.S. has the advantage of being able to rapidly develop the high technology systems that would be required to commercialize off shore aquaculture. What is missing is the regulatory system to develop this business.

The National Offshore Aquaculture Act is the beginning of a dialogue. The bill's sponsors, Senators Ted Stevens (Alaska) and Daniel Inouye (Hawaii), and Congress on the whole will examine these recommendations and undoubtedly adjust the initial language as part of the legislative process.

The Magnuson-Stevens Act—legislation that provides guidance for management of wild capture fisheries in the U.S.—is the priority fish and seafood issue for Congress. The aquaculture bill should not be far behind. Many in Congress clearly rec-

ognize that we will be unable sustain our level of consumption or expected increases in the future by relying solely on wild capture. Aquaculture is that complement to wild capture fisheries.

The 80 million metric ton difference estimated by the U.N. Food and Agriculture Organization (FAO), or "aquaculture gap," between our global wild harvest and the world's demand for healthy seafood needs to be met.

Farm-raised products are sustainable sources of food that help retailers and restaurants meet the ever-growing demand for seafood across our Nation and around the world. Aquaculture practices—traditional and marine alike—should be viewed in the public eye as a "relief valve" for wild capture fisheries, not a replacement for them.

Furthermore, aquaculture products are often a cost-effective alternative for the producer. That benefit can be passed along to consumers by expanding the kinds of fish available and reducing prices. Five of the top ten kinds of fish Americans eat are to some extent farmed, including shrimp, salmon, catfish, tilapia, and clams.

Time and again we hear the health benefits of fish and why people should include it as part of a healthy diet. Now as the level of consumption rises, the Federal Government is working to ensure we have the ability to meet that demand. This bill will strengthen that ability while ensuring appropriate safeguards are in place.

NFI looks forward to working with the Congress and with your Committee on this legislation that will help ensure a sustainable and environmentally sound resource for future generations. I appreciate the opportunity to submit these comments, and look forward to working with you on this important initiative in the coming weeks and months.

PREPARED STATEMENT OF JOHN R. MACMILLAN, PH.D., PRESIDENT, NATIONAL AQUACULTURE ASSOCIATION

The National Aquaculture Association (NAA) is the largest trade organization representing fish and shellfish aquaculture producers in the United States. Our members produce food fish, recreational fishing stock and baitfish, aquarium ornamental fish and shellfish. The NAA strongly supports the development of a national offshore aquaculture program that is environmentally-responsible and commercially feasible. The NAA offers the following comments regarding development of an offshore aquaculture legal framework, and looks forward to working with others to support enabling legislation that will assist the United States in meeting the seafood demand of present and future generations.

I. The United States Must Establish a Federal Marine Aquaculture Production Program

U.S. Demand Outstrips Current Capabilities

The U.S. consumer demand for fish and shellfish continues to rise at an increasing rate. In 2005, seafood consumption in the U.S. soared to 16.6 pounds per person.[1] Marine and freshwater aquaculture production, as well as product from capture fisheries, will be needed to meet this demand.

Presently, foreign imports overwhelmingly dominate the U.S. seafood market. In 2005, the United States imported $12.1 billion worth of seafood compared to $11.3 billion in 2004.[2] Fifty-three per cent of the 2004 imports originated in Asia.[3] Accounting for U.S. exports of $3.8 billion, our annual seafood trade deficit has reached $8.3 billion in 2005 compared to $7.4 billion in 2004.[4] Remarkably, Americans rely on imports for the majority of their seafood.

Substantial increases in the domestic capture fishing industry cannot be expected to meet projected U.S. demand. Maintaining the health of our wild seafood stocks requires careful management and monitoring. The necessity of limitations on production and fishing effort in management of natural populations can interrupt supplies to buyers, jeopardize consumer allegiance for domestic product species and cause greater demand for foreign product. Despite suggestions to the contrary, responsible management of capture fisheries cannot be expected to simply adopt aquaculture technologies in such a way as to meet demand solely through marine fishing. For example, modern hatcheries (aquaculture) produce an estimated forty percent of the harvested pacific salmon stock, but simply increasing stocking efforts will not provide reliable production increases or meet demand for other food fish species. We must look to the use of aquaculture technology to provide the substantial increased domestic production required to meet our needs for marketable seafood.

Today's Decisions May Write the Story of Our Future

For the past quarter century, Congress has recognized that our dependence on seafood imports adversely affects the national balance of payments and contributes to the uncertainty of supplies.[5] Unfortunately, not a single commercial marine finfish facility has been established in Federal waters over that period. In terms of offshore aquaculture, we have failed to even begin to implement the national policy established by the National Aquaculture Act of 1980 to "encourage the development of aquaculture in the United States."[6]

Now more than ever, food security is becoming a critical concern for all countries, and the United States is no exception. Not long in the future, the economic strength of nations, and health of their citizens, may reflect the availability of high-quality protein sources. Food security may supplant energy security as the strategic issue of the day. Our collective inability to develop the means to produce food fish in the Federal waters of the exclusive economic zone may have dire consequences that should not be ignored today.

The United States was the world's food basket. Today, in addition to unexpected foreign competition in everything from Russian wheat to Central American produce, we realize we are not immune to a variety of national food production risks. Our critical protein production industries are vulnerable to natural disease risks, intentional attacks on food supplies by our enemies, transportation disruptions, and trade disputes between nations. All such factors could affect the health of generations to come. As a nation, we would be remiss not to pursue the protein production opportunities provided by offshore aquaculture on grounds that we may be faced with challenges, or that we will need to resolve our differences of opinion regarding its costs and benefits.

II. Legislation Should Create the Mandate; Regulation Should Provide the Operating Standards

Congress should create the mandate to pursue offshore aquaculture as an important element of our food production strategy for the 21st century. However, the legislative, policy development arena is not the proper forum for creating the detailed system that must integrate new legal authorities with numerous existing legal and regulatory standards applicable to aquaculture operations in the exclusive economic zone.

Aquaculture opponents speculate that a litany of potential dire consequences will create insurmountable environmental obstacles to development of offshore aquaculture. Those opponents would prefer that enabling legislation create numerous, specific aquaculture operating criteria without the benefit of public investigation and analysis that would be performed in rulemaking. In reality, there also exist many environmental standards that can be used to address the primary issues raised by opponents. Moreover, only in notice and comment rulemaking can all stakeholders have an opportunity to participate in the detailed scientific and governmental review required to formulate a supportive yet protective program.

What is needed is a clear legislative directive to guide both detailed rulemaking by administrative agencies and potential judicial review. Congress must be unwavering in meeting its responsibility to clearly restate that the fundamental objective of the offshore aquaculture legislation is food production.

Available Water Quality Protection Standards Exist Today, Additional Regulation Is Unwarranted

Maintaining water quality is a first priority for all successful aquaculturists. The technology for doing so is readily available, and the regulatory programs to ensure protection of water quality already exist.

In 2004, the U.S. Environmental Protection Agency completed approximately 4 years of work to investigate the primary methods of aquaculture production (including coastal net pen operations), and develop discharge permit regulations.[7] The USEPA promulgated specific effluent limitation guidelines (ELGs); an unfortunate term for enforceable permit standards for aquaculture operations.[8] Aquaculture facilities are required to meet these standards as elements of their NPDES permit under the Clean Water Act.[9] In addition, the Clean Water Act and its regulations have long required additional permit standards specifically tailored for discharges to ocean waters.[10] The Federal ocean discharge regulations act to supplement ELG standards to provide an adaptive process to ensuring ocean water quality.

Ocean discharges are subject to criteria that require an assessment of their impact to biological community resources.[11] In its review of a permit application for a proposed ocean discharge permit, the EPA must consider the discharge's effect on the receiving water ecosystem, and specifically ensure that there is no "unreasonable degradation" of the marine environment.[12] The operating conditions required

to meet this requirement are developed in the permit application process, where the project factors such as location, design, proposed stock species and receiving water characteristics are taken into account in order to develop appropriate safeguards.[13] Existing Federal regulations require an evaluation of ten criteria to determine whether an unreasonable degradation of the marine environment will occur.[14] Permits cannot be issued when there is insufficient information to determine that no unreasonable degradation will occur, unless the applicant can demonstrate that: (a) the discharge will not result in "irreparable harm;" (b) no reasonable alternatives to the discharge exist; and, (c) the applicant complies with other permit conditions.[15] Permits issued under this authority are also specifically conditioned upon the risk of termination in the event that new data demonstrate that the continued discharge would result in unreasonable degradation of the marine environment.[16]

A valid regulatory permit program is available to regulate offshore ocean discharges from aquaculture facilities. The proposed legislation need not duplicate this program, and efforts to do so will only create potential conflicts and unnecessary additional regulation.

Species Restrictions and Stock Escapes

Potential impacts to native species and natural stock populations are legitimate concerns to consider in the development of offshore aquaculture facilities. However, blanket legislative prohibitions may preclude development of production technologies that are protective of native species and provide enhanced food fish production systems to the United States and others.

The aquaculture legislation should allow NOAA to review and approve proposed stock species and operating systems on a case-by-case basis, and thereby not bar the United States from the benefit of innovation and technological advancements. Sufficient levels of security for the circumstances may be achieved by incorporating a variety of safeguards. Depending on the specific circumstances, appropriate safeguards might incorporate stock restrictions (*e.g.,* triploid (non-breeding) stock), improved containment designs (*e.g.,* multiple netting, hard containment structures, vessel-contained stock) or new methods of protection not yet identified.

Offshore Aquaculture's Potential Contribution to Health Quality

The increase in domestic consumption of seafood is, in part, related to greater availability of seafood in the U.S. at competitive prices and to increased realization that consumption of seafood high in omega-3 fatty acids appears to have profound health benefits. Marine fish species, particularly those that are carnivorous, are typically high in omega-3 fatty acids relative to many freshwater species. Demand for healthy seafood is expected to grow as the U.S. population increases and as seafood health benefits become more broadly acknowledged. Offshore aquaculture presents a tremendous potential for increased supply of fresh, healthy seafood to the American consumer. It is incumbent on Congress to provide opportunity for offshore aquaculture in the U.S. EEZ to help improve U.S. public health.

Antibiotic Use Is Properly Regulated

Opponents of aquaculture often allege rampant misuse of antibiotics by producers. Such opponents speculate that such misuse will be a standard practice if we create a marine aquaculture system. This is a red herring issue. Aquaculture opponents never discuss the various Federal programs designed to ensure public health and environmental safety are maintained when the few available antibiotics are used. Critics fail to recognize the scientifically-rigorous U.S. Food and Drug Administration drug approval process. There are very few drugs approved for use in aquatic animal farming in the United States and the three approved antibiotics are only available for a few specific fish species. Ongoing efforts to develop vaccines will dramatically reduce the need for antibiotics. New drugs are strictly regulated, and must pass rigorous evaluation for their potential environmental impacts under the Investigational New Animal Drug approval process. Existing laws specifically protect the public health and prescribe the standards for management of drug use and quality assurance in marine aquaculture.

Alleged Aquaculture Health Risks Are Unfounded

Some aquaculture critics express fears that antibiotics used in aquaculture will harm the surrounding environment or lead to antibiotic resistance in humans. In fact, there is no credible scientific literature documenting environmental harm from the extremely low concentrations of antibiotics occurring in the environment due to treatment of aquatic animals. Moreover, antibiotics are not used to protect fish (*i.e.,* prophylactic use) nor are they used to promote growth in domestically reared fishes. The only antibiotics approved for use in the U.S. domestic aquaculture industry are approved to treat specific bacterial diseases in specific kinds of aquatic animals.

Similarly, critics often mistakenly claim that hormones are used in aquaculture to promote growth. In fact, there are no U.S. FDA approved hormones for growth promotion of aquatic animals. Critics also fail to identify the ongoing efforts of the Federal Joint Subcommittee on Aquaculture to develop a national aquatic animal health plan. Last, opponents of offshore aquaculture argue that farming of aquatic animals will create disease or enhance disease of wild fish. In fact, infectious diseases affecting farmed aquatic animals already occur in the wild. The pathogens causing aquatic animal disease in marine species are most frequently transferred from wild fish to farmed fish.

III. Fundamental Issues Must Be Addressed in Legislation in Order To Create a Viable Program

A. The Proper Role of the States

The coastal states have a legitimate interest in the development of offshore aquaculture and may have aquaculture experience that would assist in the evaluation of offshore marine aquaculture projects. The Federal process for review of offshore marine facilities must include state participation procedures. However, the potential adverse impacts of aquaculture in Federal waters must be kept in perspective. Unlike other projects that may potentially create greater, wide-range impacts to state water quality, such as offshore oil and gas production facilities, marine aquaculture facilities beyond the limits of state waters are unlikely to create similar concerns.

Offshore marine facilities in Federal waters should not be required to receive a formal state consistency determination under the Coastal Zone Management Act unless the facility is reasonably likely to violate state marine water quality standards or violate an approved state coastal management program requirement in state jurisdiction waters.[17] Any land-based operations or related industries that support offshore aquaculture should be reviewed under the applicable local zoning regulations and related coastal zone management standards that are part of that review.

State Veto Authority Must Be Limited

Giving states the ability to close Federal waters to offshore aquaculture creates a dangerous precedent, and is inconsistent with the national objectives of the proposed legislation. States should not have *carte blanche* authority in Federal waters; whether it concerns the operation of proposed aquaculture facilities, management of fish stocks, or the presence of nuclear-powered vessels or armaments in the U.S. exclusive economic zone.

There would be little incentive for private industry to develop offshore production facilities if their operation could be terminated and investment forfeited by subsequent state opt-out decisions. Any opt-out authority provided to states must be reasonably limited in scope and reflect a valid public policy purpose. States should be limited to a one-time opt-out decision, and should be required to notify NOAA of their opt-out decisions within 6 months of promulgation of the program regulations. The state opt-out decision also should be limited in effect to only the area within five nautical miles from the state-Federal boundary. A similar procedure could apply to state-Federal boundaries areas that create jurisdictional "donuts." The five nautical mile boundary area could be considered a rationally defined setback area to further protect state waters from potential aquaculture facility impacts. Naturally, NOAA would still be able to consider specific impact factors and additional, appropriate protective standards under regulations established for review of proposed facilities.

An additional limitation needed to support the concept of a legitimate decision by states to remove Federal waters from potential development would be to condition a state opt-out decision upon the existence of a corresponding state prohibition of finfish or shellfish aquaculture in state waters. It would be unreasonable to allow states to prohibit aquaculture in neighboring Federal waters when such activities are allowed in state waters.

B. Aquaculture Is Not a Fisheries Management Issue

The NAA strongly supports exempting offshore commercial aquaculture from regulation under wild fisheries management programs such as the Magnuson-Stevens Fishery Conservation and Management Act and the jurisdiction of the fisheries management councils.[18] As is the case with other Federal entities with offshore responsibilities, the Councils should be provided with an opportunity to comment on proposed offshore aquaculture programs but not be provided with approval or veto authority, or the ability to regulate aquaculture operations. The only proper application of such a management program with respect to offshore aquaculture is the regulation of the release of farmed fish under wild stock enhancement programs. Oth-

erwise, aquaculture fish stocks are to be recognized as private property; they are not part of a wild fishery resource.

Fish farm operations also should not be subject to standards established by the Councils that are not part of the regulations promulgated under authority of the proposed offshore aquaculture legislation. While Congress is only now first considering offshore aquaculture enabling legislation, some Councils have already produced onerous environmental and operations policies for potential aquaculture operations in the exclusive economic zone. These policies have been drafted without the benefit of formal rulemaking processes, or rulemaking safeguards with respect to economic evaluations, small business considerations or protections against anticompetitive effects. Congress should confirm that the evaluation, approval and operation of offshore aquaculture facilities will be performed under the regulations promulgated by NOAA to implement the aquaculture legislation, and that such operations are not intended to be regulated by policies created by the Councils under the wild resource programs. Of course, there are also other existing regulations and specific statutory directives for regulating aspects of Federal offshore aquaculture, such regulations under the Federal Water Pollution Control Act and regulations of the U.S. Environmental Protection Agency.[19]

C. Site Permit Terms

The proposed offshore legislation establishes a site permit to authorize an aquaculture production facility in Federal waters. The proposed term of this permit is an initial period of 10 years, renewable at 5 year terms thereafter. This approach does not present a viable development and investment option. The proposed length of the site permit presents a significant obstacle to business and financial planning. Offshore aquaculture operations will be expensive, and will typically require private sector financing. The uncertainty created by potential disruption of established operations after a 10 year initial permit periods will create too great a degree of risk. The transaction costs attendant to initial permitting of production sites, and potential additional costs to re-permit initial sites, or new sites, is a substantial burden that must be supported by product prices. These significant transaction costs may make product prices unmarketable.

By comparison, other Federal leases that authorize the consumptive use of public trust resources (as opposed to use of a site for private resources) provide even longer use periods than the proposed aquaculture legislation. Federal oil and gas leases run for twenty years.[20] Federal deep seabed mineral leases run for initial recovery periods of twenty years, and indefinitely thereafter if minerals are being recovered.[21] The term of aquaculture site permits should be extended to initial periods of twenty-five years, and should be renewable for terms of twenty-five years. Shorter periods result in business instability, substantial overhead and transaction costs, and potential lease speculation that could create bidding wars for established production sites. The objective of Federal legislation should be reliable production of food fish, not speculative markets in production sites.

IV. Aquaculture Development in a Global Market

Large-scale marine aquaculture of the type likely to be considered for development in the U.S. exclusive economic zone is being undertaken in many other countries as we speak. In fact, we must recognize that this type of operation will be a much larger scale and more capital intensive than most other forms of aquaculture in the United States. As such, many of those who would consider undertaking these projects will readily evaluate foreign development locations as alternatives to development in the United States. To the extent that we create obstacles to development in this country, marine aquaculture projects will be located in Australia, Belize, Canada, Chile, China, Mexico, Norway, New Zealand, Scotland, Spain, Vietnam and other countries. The transportation requirements do not present a significant barrier to U.S. markets from these locations, particularly when we consider the disparity in labor costs and regulatory costs.

If we are to have any hope of creating a commercial offshore aquaculture industry in the United States, and addressing food security requirements and the current seafood trade imbalance, we will have to eliminate existing unwarranted barriers to development and create a reasonable program for evaluation and approval of offshore aquaculture projects.

Thank you for the opportunity to provide these comments.

ENDNOTES

[1] U.S. Department of Commerce, NOAA, Import and Export of Fishery Products Annual Survey 2005 ("Survey 2005"), (*http://www.st.nmfs.gov/st1/trade/documents/TRADE2005.pdf,* visited April 2006).

[2] Id.; NOAA, Fisheries of the United States 2004 (Fisheries 2004), p. 53, (*http://www.st.nmfs.gov/st1/fus/fus04/08_perita2004.pdf*).
[3] Id., p. 55.
[4] Survey 2005, Fisheries 2004, p. 53.
[5] National Aquaculture Act of 1980, 16 U.S.C. 2801 et seq., 16 U.S.C. 2801(a)(2).
[6] National Aquaculture Act of 1980, 16 U.S.C. 2801 et seq., 16 U.S.C. 2801(c).
[7] See, 69 FR 51891, 51897 (December 23, 2004).
[8] See, 40 CFR Part 451.
[9] 33 U.S.C. § 402.
[10] 33 U.S.C. 403; See also, 40 CFR §§ 125.120 through 125.124.
[11] 40 CFR § 125.122(a)(3).
[12] 40 CFR §§ 125.121(e), 125.122.
[13] 40 CFR § 125.122.
[14] 40 CFR § 125.122(a).
[15] 40 CFR § 125.123.
[16] 40 CFR § 125.123(d)(4).
[17] See, 16 U.S.C. § 1456(c)(3)(A); See also, 16 U.S.C. § 1453(1).
[18] 16 U.S.C. 1801 et seq.
[19] 33 U.S.C. 1251 et seq., 40 CFR Part 451.
[20] 30 U.S.C § 223.
[21] 30 U.S.C § 1417(b).

PREPARED STATEMENT OF BRIAN O'HANLON, PRESIDENT, SNAPPERFARM, INC.

Dear Committee Members,

Many of the negative comments I heard at the hearings unfairly and inaccurately portrayed our fledgling industry and products. We (our company and colleagues) are very sensitive to all environmental issues and other concerns surrounding our industry and work very hard to produce some of the most environmentally responsible, healthy and safe seafood products available to American consumers.

The following are some of the key issues I heard being discussed at the hearing and my comments on each issue. In an effort to maintain transparency with respect to these issues and concerns, we try to post as much nonproprietary information on our website as we can. If you are interested in additional information to support my comments I will be happy to provide it upon request.

Environmental Impact: Senator Boxer from California worried that offshore aquaculture will "create clouds of ammonia, phosphorous and other waste". Dr. Rebecca Goldberg calculated that a $5 billion offshore aquaculture industry will discharge waste equivalent to 17 million people or the entire North Carolina hog industry.

It sure sounds dramatic and complicated when it is explained that way, but when describing what impact Rebecca's $5 billion industry will really have on the EEZ Randy Cates put it in simpler, less dramatic terms. Norway's entire $1.8 billion salmon industry has the footprint equivalent to a large runway in the U.S. while the EEZ is roughly the same size as the continental U.S. Now consider that this footprint and loading is going to be divided among dozens or even hundreds of farms spread out over a couple of million square miles in the EEZ.

We must consider the staggering volumes of water that will move through these farms on a daily basis. For example, at our site in Puerto Rico, we have an exchange rate in each cage of over 1,000 times per day which equates to over 2 billion liters of clean seawater flowing through every cage every day. Over the past 4 years, NOAA has funded two detailed environmental studies (reports available on our website) at our farm site. Both were conducted by the University of Miami and University of Puerto Rico and both proved that there is no significant environmental impact from our operation. Even if we tried to, I do not think we can create the dramatic impact described by Senator Boxer.

Social Impacts: Comments were made at the hearings that suggested that offshore aquaculture products will compete with and eventually displace segments of the U.S. fishing industry.

Whether or not offshore aquaculture develops in U.S. waters, the U.S. fishing industry will compete with aquaculture products in the U.S. markets. If the products are not produced domestically, they will be produced overseas, imported and consumed in the U.S. Offshore aquaculture should grow to work with and compliment the U.S. fishing industry. None of the species of fish currently being produced offshore in U.S. waters are competing with a wild capture

fishery of the same species. In addition, it is not biologically, technologically or economically feasible to produce all seafood products through aquaculture.

Fishmeal Use: Comments were made at the hearings that suggested offshore aquaculture consumes more protein from the wild than it creates.

Approximately one third of the world's fishmeal and fish oil is consumed by aquaculture while the other two thirds are consumed by pig and chicken industries. Fish are far more efficient at converting fish-based proteins into biomass than any other farm raised animal. In just 4 years operating our farm in Puerto Rico, we have dramatically improved the growth efficiency of our crops. Most of the protein in our feed comes from grain based products, while the smaller amount of fishmeal in our feed comes from a carefully managed fishery in the U.S. One of our primary goals is to constantly improve growth efficiency and reduce the total amount of fishmeal used in our feeds. A tremendous amount of research is being conducted around the world to develop substitute protein sources that still retain the health benefits of fishmeal and fish oil. We strongly believe that the industry will grow to reduce its reliance on wild fish protein. We are already headed in that direction.

Product Safety: Senator Boxer questions whether this industry will be helpful or harmful to the future health of our children and fisheries. Dr. Rebecca Goldberg questioned the health risks of farm raised fish because of trace levels of PCBs and other contaminants.

Most foods we consume such as beef, chicken, pork, milk, butter and cheese contain very small traces of PCBs and other contaminants. American consumer ingests far more of these contaminants from these other food items than they would from fish. Our fish are tested for PCBs and other contaminants. The certified labs conducting the tests have not detected any trace of PCBs or contaminants in our fish. In addition, our fish are very high in heart healthy Omega-3's and other essential fatty acids. The reason for our clean, safe and very healthy fish products are the clean, safe and high quality ingredients used in our feeds.

American consumers should be more concerned with the fact that if we do not produce these fish here in the U.S. where the industry and products will be highly regulated, it will be done somewhere else where there is less, little or no regulatory oversight when it comes to environmental impacts and product safety. If we do not substantially increase domestic aquaculture production, importing foreign aquacultured products will be the only choice for the American consumers increased demand for seafood.

Consumer Acceptance: Senator Boxer mentioned that consumers in the State of California prefer wild fish over farm raised fish and that this is a trend that will spread across the country.

While this may be the case for a select group of people, we think that generally, Americans will choose their seafood based on value, quality and availability. This is certainly the case for farmed salmon, shrimp, tilapia and other cultured products. Our customers have a choice when buying our cobia products. They can purchase wild cobia from South America or farm raised cobia from Vietnam. They repeatedly choose our fish over the others even with a 50 percent price premium because of the superior quality, value and the peace of mind knowing the fish has been carefully cared for its whole life.

Exotic Species: There were concerns from many Subcommittee Members and some panel members about exotic species escaping from the cages.

We believe that exotic species should not be allowed for culture. Offshore farms should only be allowed to farm species of fish that are native to their waters.

Escape: There is concern that fish will escape from cages and breed or compete with wild fish for habitat and food source.

The last thing a farmer wants is to lose valuable crop, but it is nearly impossible to guarantee that no fish will ever escape from offshore farms. If we use native and nongenetically-modified fish the risks associated with escape are reduced or eliminated. We are constantly working closely with our cage manufacturers to improve on already great cage designs. Improvements in cage technology are moving at a rapid pace. Just like our computers, the day after our cages are installed, there is a better model available.

Disease and Drug Use: Concerns were raised at the hearings about disease outbreaks among fish crowded in offshore cages and the disease transfer from the farmed fish to wild fish. Concerns were also raised about the use of antibiotics and other drugs to treat diseases.

One of the benefits of moving offshore is that we provide a healthier environment for our crops of fish. Because of strong currents, the water exchange rate is very high and because of the depth and vastness of the offshore waters, our fish never see the same water twice. Proper farm management practices such as the use of high-quality diets and reasonable stocking densities also help to prevent disease. We believe that the salmon industry experienced early problems with disease interaction between farmed and wild fish partly because the farms are located in areas that are migratory routes and are frequented by wild salmon. Currently, this is not the case for the species of fish being produced offshore.

If not properly administered, antibiotics and drugs can impact surrounding ecosystems and product health. However, the drugs used in the U.S. are highly regulated and the frequency of use offshore should be minimal because of the healthier environment described above. The salmon industry has come a long way with the development of vaccines for their crops. With the right resources, this vaccination technology can be modified and adapted for use with a wide variety of marine fish species.

We do agree that offshore aquaculture expansion should not go unchecked and a proper regulatory structure will help weed out poorly planned and managed projects. However, the existing regulatory structure is too expensive, complex and overburdening for even the most serious and well organized businesses. I can easily claim that the regulatory system is the single largest constraint to the growth of our business. We strongly support the goals of the Offshore Aquaculture Act of 2005. However, I have a few comments I would like to make regarding the bill.

Permit Terms: We believe that the proposed time period for the permits (10 years and renewable for an additional 5 years) is too short. Offshore aquaculture operations take a tremendous investment in capital and time to start. It will be difficult to justify this investment without the security of longer-term permits.

State Opt-Out: It is clearly a state's right to not want this industry to develop just outside of its costal waters. However, the state should make this determination before farms are established. It is not fair to the private industry to have their permits canceled with such short notice if the state decides at a later date that it does not want the industry offshore.

Government Support: The government must invest substantially more financial and research support to further the development efforts of private, academic and nonprofit organizations. Our company has endured a substantial share of the cost burden in bringing the offshore aquaculture production of cobia to commercial reality in the U.S. The same can be said for the companies in Hawaii with respect to their products.

Our company and our colleagues are working hard to develop a responsible, highly productive industry in the U.S. If you focus too much on the misconceptions I heard emphasized at the hearings and not the facts, you are going to force the technology, jobs and income to other countries where there will likely be less regulatory oversight, less regard for the health of the environment and less concern for product quality. You have a tremendous amount of influence in the future of offshore aquaculture in the U.S. Please consider the facts, not misconceptions when determining our future.

Thank you for the opportunity to provide my input.

PREPARED STATEMENT OF WILLIAM TAYLOR, PRESIDENT, TAYLOR SHELLFISH FARMS

Taylor Shellfish Company is a large (perhaps the largest in the United States) producer of farmed molluscan shellfish. Beginning in the 1880s we've taken five generations of experience and coupled it with modern technology to create state-of-the-art production facilities for Manila clams, a variety of oyster species, mussels and geoduck clams. Most of these are produced on approximately 9,000 acres of tidelands we own or lease here in Washington with the exception of mussels which are grown suspended from rafts. We ship seed and mature shellfish all over the world.

I am writing today in support of Congress passing authorizing legislation that will allow and encourage environmentally responsible aquaculture in the U.S. Exclusive Economic Zone (EEZ). Taylor Shellfish belongs to the National Aquaculture Association and fully supports the detailed comments submitted by them regarding the offshore aquaculture legislation. We would welcome Federal legislation which would increase opportunity for domestic aquaculture and provide a commensurate national research and development program.

Our company employs approximately 380 people full time at our hatcheries, nurseries, farms and processing facilities in the Unites States and typically add another 30–40 employees seasonally. Collectively these employees earn about $12.3 million annually and most have medical, vacation and retirement benefits.

In recent years, Taylor Shellfish Company has been expanding to include operations in Canada, Fiji and Mexico. Our decision to locate in foreign waters has in part been driven by opportunities in other countries where aquaculture development is supported and encouraged. Less stringent environmental standards are not the appeal. In our experience they have been similar. Most significantly, aquaculture is desired in these countries, public policy facilitates it and there are research and development programs which support it.

In Totten Inlet, Washington, which is in the southern part of Puget Sound, our company currently has two mussel farms. We lease approximately 11 acres from the state on which we anchor these farms. The surface area actually covered by rafts is far smaller. These farms were permitted between 1992 and 1994. Together they produce approximately 1.5 million pounds of mussels annually. We have been attempting to get a third farm permitted in the same inlet since 1997. The 58, 30′ x 38′ rafts proposed for the new farm would cover approximately two acres of the surface. Unfortunately recent shoreline development, occurring since the earlier farms were permitted, has brought with it an onslaught of new competing uses, not the least being a desire for an unobstructed view. The legal challenges and environmental study required to site this new farm have cost hundreds of thousands of dollars and delayed the project years. As none of the required studies to date has found evidence of negative environmental impact, we anticipate we will ultimately prevail on getting this new farm permitted.

To meet market demand for mussels while fighting to site a third farm in Totten Inlet, we have purchased three farms in British Columbia. These three farms collectively provide us approximately 250 acres of surface area on which to anchor rafts and culture mussels. Currently we employ 12 people in BC who earn approximately $400,000 collectively. We are now looking for an appropriate location to build a hatchery and processing plant in British Columbia to accommodate these farms and facilitate their full development. This will ultimately represent 40–50 good paying full time jobs that could have been located in the United States.

While state and local land use laws are the main culprit for our problems in Totten Inlet, not the Federal Government, we can't help but wonder if the outcome would have been different were the United States actually implementing a National Aquaculture Development Plan that promoted aquaculture (called for by the National Aquaculture Act of 1980). Perhaps Washington State would have a State Shoreline Management Act that supported the National Aquaculture Development Plan which would have provided direction to local governments to do the same. Perhaps NOAA would have had aquaculture coordinator positions in their regional offices, testifying supportively at local permit hearings. Perhaps Washington State would be seeking our jobs instead of shunning them.

Seafood demand as you heard in your April 6th hearing continues to rise and demand will not be met by wild fisheries alone. According to NOAA's 2002 document *The Rationale for a New Initiative in Marine Aquaculture,* aquaculture is the fastest growing food industry in the world. While global aquaculture production has grown at an annual rate of 10 percent, the growth of aquaculture in the United States has been only 1 percent—and most of that has been in the fresh water environment.

Part of our decision to locate in other countries is because public policy here in the United States is not conducive to aquaculture development. Actually, to be more accurate, Federal public policy, in particular the National Aquaculture Act of 1980 and aquaculture policies at the Department of Commerce and National Oceanographic and Atmospheric Administration are very supportive.

Unfortunately the rubber has yet to meet the road when it comes to implementing these laws and policies. To the contrary, it has only become more difficult in recent years to continue to operate existing farms, never mind expanding operations.

Opportunities for shellfish culture in the EEZ are limited, at least with today's technology. That could clearly change in future years with advances in technology. Despite the limited opportunity we support the legislation to preserve future opportunity. The shellfish industry could see immediate growth opportunities if NOAA were to develop a comprehensive marine aquaculture program which included facilitating nearshore aquaculture development. This could be through research and development and aquaculture zoning under Section 309 of the Coastal Zone Management Act.

Thank you for consideration of these comments.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. OLYMPIA J. SNOWE TO DR. WILLIAM T. HOGARTH

Regulatory Streamlining

Question 1. Why does the Administration's bill propose having two separate permits for siting and operations? Would these replace, or be in addition to, other state and Federal permits? As we now have an opportunity to design a permitting system from scratch, how can we take steps to reasonably integrate these permits?

Answer. The two-permit system was designed to give industry long-term security of tenure along with the flexibility to modify operations over time (e.g., in response to changing technology and market conditions). The site permit allows a permit holder to use a specific area of the ocean for aquaculture for 10 years, renewable every 5 years. The operating permit covers what the site permit holder could do at the site [e.g., type of structure, species, operational details, etc.]. If a site permit holder wanted to switch to a different type of operation or grow a different species, the operating permit could be amended without affecting the site permit.

The Administration's bill will not override existing laws, but it does call for a coordinated permit process to address the legal and regulatory requirements under other statutes. It also authorizes other Federal regulatory agencies to modify their regulations to implement the coordinated permit process. For example, the bill preserves the roles and responsibilities of other Federal agencies in establishing environmental requirements under current law, while giving the Secretary of Commerce authority to impose additional requirements specifically relating to offshore aquaculture activities for which permits are issued under this Act. The intent is to avoid duplicative and/or conflicting requirements, allow the Secretary to fill in any gaps or deficiencies in such environmental requirements, and facilitate the identification of all requirements that apply to an offshore aquaculture operation regardless of which Federal agency has primary responsibility.

Question 2. Should the law mandate an integrated state-Federal permitting process, a "one-stop shop" for all permits, or other specific measures? What other steps could NMFS take to reasonably improve the efficiency of the permitting process?

Answer. As stated in Dr. Hogarth's testimony, an offshore aquaculture bill provides the Department of Commerce the authority to directly regulate aquaculture in Federal waters, and to establish a coordinated process among the Federal agencies. We envision a one-stop regulatory shop, coordinated by NOAA, and integrated into NOAA's environmental stewardship responsibilities. S. 1195 does not specifically address the integration of a state-Federal permitting process, as referenced in the question, but the bill does call on NOAA to consult with the states in drafting implementing regulations and in the review of Federal permit applications.

NMFS is already taking steps to improve the efficiency of the aquaculture permitting process under current law by developing guidelines and reference materials for use in the review of proposed aquaculture facilities in coastal waters under the Magnuson-Stevens Fishery Conservation and Management Act and the Endangered Species Act. Future steps could include the designation of aquaculture coordinators for each region to provide a local point of contact for permit applicants.

Role of Regional Fishery Management Councils

Question 3. We need to consider the serious issues about how offshore aquaculture would affect Federal fisheries management, and vice versa. NOAA's proposed bill would exempt offshore aquaculture from the Magnuson-Stevens Act, but clearly we have to make sure that aquaculture is compatible with the conservation and management work of the Regional Fishery Management Councils. NOAA's bill would require it to consult with these Councils in the permitting process, and one of Senator Stevens' amendments would require Council consultation in setting environmental requirements.

What specific activities does NOAA envision when NOAA "consults" with Councils under your bill—mere information sharing, or a more substantial review and comment process? What else? Should we be more specific in the Act about what "consult" means?

Answer. The implementation of an offshore aquaculture bill will complement NOAA management responsibilities over wild fisheries and resolve some of the challenges the agency has faced trying to manage aquaculture under laws, regulations, and fishery management plans written for wild harvest fisheries. Once a bill is enacted, NOAA envisions that a substantial role for the Fishery Management Councils will be developed as part of the implementing regulations. A well-defined role for the Councils in the consultation process will be critical to the success of the permitting process for aquaculture in Federal waters.

Under S. 1195, NOAA would consult with the Councils in the development of regulations, in the establishment of environmental and other requirements (especially as they relate to interactions with wild stocks managed by the Councils), and in the review of individual permit applications. In anticipation of the rulemaking process, NOAA is working with the Councils to explore an appropriate consultation process for Federal aquaculture permits.

NOAA does not believe a more specific statutory definition of "consult" is necessary. The role of the Councils—including the definition of "consult"—will be clarified as part of the rulemaking process once the bill is enacted.

Question 4. Does NOAA support the amendment to require additional consultation with councils in setting environmental requirements? What other specific aquaculture-related activities require consultation between NOAA and the councils?

Answer. The Administration supports the inclusion of language requiring consultation with Fishery Management Councils in setting environmental requirements, as well as in the development and implementation of the permitting process. Councils may also be consulted to help identify areas of the U.S. Exclusive Economic Zone (EEZ) where offshore aquaculture would be least likely to interfere with known fishing activities and other marine managed areas.

Question 5. Although we do not have fisheries management councils represented here today, do you think councils now have the staff and financial resources to become properly involved in this new consultation function?

Answer. We anticipate that enactment of this legislation will not impose significant additional work on the Fishery Management Councils.

Funding Authorizations

Question 6. Currently the Administration's bill proposes that we authorize "such sums as may be necessary" for implementing this Act. As you can imagine, that is a very difficult request in this budget climate. As authorizers, we simply must have more specific information from you on what funding is needed and what elements of the program it would go toward.

Given your expertise in the costs associated with regulating major industries, how much funding would NOAA require to implement the Act it has proposed?

Answer. NOAA estimates that the cost of implementing S. 1195 would be under $2.5 million annually over a period of 3 to 4 years. This estimate, which is based on experience with other permit programs, includes funding to develop implementing regulations. This estimate does not include funds for demonstration projects and other research and development in support of regulatory decisions.

Question 7. Out of this funding, exactly how would NOAA spend it? For example, how much would it allocate to research and development, program administration, monitoring and enforcement, and so on?

Answer. Implementation of S. 1195 would include stakeholder meetings, *Federal Register* notices, drafting of regulations, design and issuance of the permit system, monitoring requirements, Geographic Information System (GIS) mapping, and compliance with NEPA to the extent applicable.

Question 8. Does NOAA currently have the necessary staff and expertise "in-house" to implement this Act? How many staff members would be needed to effectively and efficiently administer this program?

Answer. NOAA has in-house staff and expertise to begin the implementation of the National Offshore Aquaculture Act, and our budget requests reflect required staffing. Full implementation of the bill, assuming significant industry interest in applying for offshore aquaculture permits, could require additional staff, including personnel to administer, monitor and enforce permits. Although the exact number of additional staff needed will depend on the level of permit activity, we expect any increase in staffing to be gradual and incremental to address identified needs.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO DR. WILLIAM T. HOGARTH

Environmental Concerns, Introduced Species, and Disease

Question 1. Both nearshore and offshore aquaculture raise many environmental concerns, from water quality to disease. For example, fish that escape from aquaculture facilities may harm wild fish populations through competition or interbreeding, or by spreading diseases and parasites. An issue of increasing concern is the possible introduction of non-native species. This is a particularly acute concern in Hawaii. In the United States, many cultured marine species are not native to

the area where they are being farmed. Non-natives may establish new populations that may out-compete native populations for food and habitat.

How can we ensure the protection of wild stocks from the potential dangers of invasive species, genetic contamination, or disease?

Answer. S. 1195 would authorize the Secretary of Commerce to impose specific terms and conditions on permits. NOAA will be able to use its authority to require appropriate management measures to protect wild stocks and prevent and mitigate adverse environmental impacts. We can protect the marine environment—including wild stocks—through careful planning, proper management, and the implementation of and adherence to environmental standards. Specific examples of planning and management actions that will help ensure the protection of wild stocks include proper siting, species selection, facility design, implementation of and adherence to best management practices, and the application of aquatic animal health practices in aquaculture that have proven effective. NMFS believes these actions and techniques are the best defense against the introduction of invasive species, genetic contamination, and disease.

All of the open ocean aquaculture efforts currently in the United States involve species native to the region in which the demonstration project or commercial operation is located. For example, the University of New Hampshire's Open Ocean Aquaculture project raises blue mussels, cod, haddock, and halibut—all native to the Northeast region. The open ocean operations in Hawaii raise Pacific threadfin and yellowtail, both native to the islands. Under S. 1195, anyone requesting a permit for a non-native (and therefore potentially invasive) species would need to demonstrate that the risks to the environment or wild stock would be negligible. There are well-established scientific protocols for considering and testing the use of non-native species. With careful broodstock management, selective breeding protocols to minimize risks to wild stocks, and technologies and good management practices to prevent escapes, the culture of indigenous species should present few, if any, risks to wild stocks.

It is also important to note that aquaculture operations in the United States have never raised genetically modified fish in coastal waters—another concern often raised in the context of non-native species. For years, NOAA and other agencies have studied the genetic and other interactions between hatchery and wild fish as part of existing stock enhancement programs for commercial and recreational fishing. Based on that experience, which includes the deliberate releases of finfish, oysters, and crabs for replenishment, it will be possible to design appropriate safeguards for conserving wild stocks.

NOAA is also aware of aquatic animal health issues based on research over the past 25 years. Comprehensive aquatic animal health programs that entail health experts administering vaccines and monitoring aquatic species further reduce the possibility of negative impacts on wild resources by cultured aquatic animals. Because aquatic animal pathogens occur naturally in open waters and wild marine organisms serve as natural reservoirs for these disease-causing agents, disease outbreaks may occur in both wild and farmed aquatic animals. There is little scientific evidence to link disease episodes in wild populations of fish, caused by endemic pathogens, to cultured animals.

In its work with the U.S. Departments of Agriculture and the Interior and with other Federal agencies, NOAA is at the forefront in developing a National Aquatic Animal Health Plan that will provide for safe national and international commerce of aquatic animals and the protection of cultured and wild aquatic animals from foreign pests and diseases. Technological and scientific advances also continue to refine aquatic animal health practices. For example, as a result of scientific advances, the marine aquaculture industry has largely replaced antibiotics with vaccinations administered before fish are stocked into cages.

With these factors in mind, NOAA will continue its focus on research and technology development that will lead to more environmental safeguards. NOAA will also continue its work with stakeholders to create an opportunity for aquaculture in Federal waters so the industry develops in a predictable, environmentally compatible, and sustainable manner, in cooperation with our wild harvest.

Question 2. What kind of environmental safeguards have effectively addressed public concerns about these and other environmental problems?

Answer. Based on over 30 years of improvements to marine finfish aquaculture practices in the United States and abroad, the most effective environmental safeguards to address public concerns are technological innovation, best management practices, careful species selection, and proper site selection.

Today's aquaculture cages, pens, and anchoring systems are more robust, and have dramatically reduced the number of escaped fish. We expect these types of

technological innovations will continue to develop. For example, new equipment for open ocean conditions has been developed and refined in the past 10 years.

Best management practices to ensure that aquaculture operations minimize risk and operate safely and securely have also been developed and refined over time. Some standard management practices used today to reduce or mitigate the risks associated with aquaculture include:

- Regular inspections by divers to ensure the integrity of nets and net infrastructure.
- Cameras and surveillance to monitor efficient use of feed, which reduces discharges of uneaten feed into the marine environment.
- Regular health inspections to prevent disease.
- Comprehensive sanitary and biosecurity programs to prevent the introduction and/or spread of pests or diseases from one farm site or cage to another or into the marine environment.

Another key environmental safeguard, species selection, is one of the most effective techniques available to reduce the impact of escapes. The knowledge NOAA and other agencies have gained with regard to species selection from over 30 years of stock enhancement research and programs to support commercial and recreational fisheries will allow managers to design safeguards for conserving wild stock.

NOAA is advocating careful site selection as one of the keys to minimizing environmental risk and maximizing environmental benefits of aquaculture—no matter what organism is under culture. Local site characteristics will dictate the proper organism or mix for that site, as all areas do not have the same environmental conditions and concerns. In some cases, it may be important to encourage a mix of organism types, including cultured finfish, filter feeding mollusks, marine algae, and other taxa. These decisions will depend on which species, or mix, will provide the maximum benefits with the smallest ecological footprint.

Question 3. What are realistic expectations of what aquaculture can do for the United States to improve our economic returns, food supply, and balance of trade?

Answer. Economic returns will ultimately depend on market conditions and costs of operations, including the costs of complying with government regulations. Offshore aquaculture has great potential to make a significant economic contribution, but this potential will be realized only if we can provide the regulatory certainty for businesses to make sound investment decisions. S. 1195 will give NOAA the authority it needs to provide that regulatory certainty.

By enacting legislation to allow offshore aquaculture to develop in the United States, we are creating opportunities for coastal communities struggling with issues of overcapitalization and limited harvests in commercial fishing. With a more robust domestic aquaculture industry, boats used for fishing could also be used to service aquaculture operations. Similarly, seafood industry infrastructure could be used for the processing and distribution of aquaculture and wild harvest fishery products. Domestic aquaculture could provide a steady, year-round source of product and, in some locations, it could prevent processing facilities from closing down altogether due to insufficient harvest from wild fisheries.

NOAA is working with top social scientists and economists across the Nation to analyze the economics of marine aquaculture as it relates to commercial and sport fishing, market opportunities, global trends, underused processing capabilities, value-added niche markets, and coastal job development. The results of this analysis will be available in late 2006.

Preliminary economic assessments by NOAA indicate that the development and expansion of marine aquaculture in the United States could trigger a ripple effect throughout the economy. Additional jobs and economic benefits from aquaculture production could accrue throughout the U.S. seafood value chain and among suppliers to the aquaculture industry, such as boat owners, fishermen, feed and equipment manufacturers, processing, feed suppliers (e.g., the soybean industry), cold storage operators, seafood marketers, and the food service industry.

Preliminary production estimates indicate that the United States could increase domestic aquaculture production of all species to 1 million tons per year by 2025. The additional production could include 760,000 tons from freshwater and marine fish aquaculture, 47,000 tons from crustacean production and 245,000 tons from mollusk production. Of the 760,000 tons of finfish aquaculture, 590,000 tons could come from marine finfish aquaculture.

Question 4. How much growth can we reasonably expect for the U.S. offshore aquaculture industry with all the competing uses of our coastal areas, particularly when combined with our need to provide adequate protection for wild stocks, environmental conditions, and—of course—the people who have to live with the choices?

Answer. Prospects for future growth of offshore aquaculture in the United States depend on many factors, including the details of the regulatory structure that would be developed under S. 1195. The industry will be operating and competing in a global market, where a range of economic factors (e.g., consumer demand and the costs of labor, capital, and competing products) will determine the commercial viability of U.S. operations.

It is also important to address concerns for protecting the marine environment. Based on 25 years of scientific research, technology development, extension work, development of best management practices, and advances in stock enhancement techniques, NOAA is confident that concerns can be addressed effectively through proper siting and operation of aquaculture facilities, followed by careful monitoring.

The U.S. Exclusive Economic Zone is 3.4 million square miles. NOAA is confident there are enough appropriate sites where aquaculture facilities could operate without compromising the protection of wild stocks, environmental quality, or people's livelihoods. In the long run, U.S. fishing communities will be harmed more by foreign competition than by a robust domestic aquaculture industry. The challenge is to find ways for our domestic fishing industry to benefit from the use of aquaculture technologies to produce additional seafood—as fishermen are doing in some parts of the United States and in other countries.

Foreign Ownership

Question 5. The Administration's bill allows for foreign ownership of aquaculture permits. However, we do not allow foreign fleets to fish in the EEZ, and we require that fishing companies be U.S. owned or controlled. Senators Inouye and Stevens introduced an amendment to the bill that deleted the Administration bill provision that would have allowed foreign citizens to hold permits.

The Administration's proposal would have allowed for foreign citizens to own and operate offshore aquaculture facilities in the U.S. Exclusive Economic Zone (EEZ). Why was this provision necessary?

Answer. With the Inouye-Stevens amendment, the provision would require that offshore aquaculture permit holders be a citizen or resident of the United States, or a corporation, partnership, or other entity organized and existing under the laws of a state or the United States. This provision was included in the bill because the development of offshore aquaculture by foreign entities can provide many of the benefits to the United States that operations by U.S. entities would provide—from creation of jobs in the United States to reductions in the U.S. trade deficit. The Administration bill does not foreclose offshore aquaculture opportunities to foreign persons, as long as such persons agree to be subject to the jurisdiction of U.S. courts with respect to activities related to a permit. The provision is consistent with our international trade obligations.

Question 6. How much foreign investment and ownership do you anticipate in offshore aquaculture?

Answer. Most of the interest in offshore aquaculture to date has come from U.S. entrepreneurs and investors. However, given the more advanced development of aquaculture in other countries, it would be unrealistic to expect zero investment by non-U.S. citizens and aquaculture companies. Foreign investment and ownership will depend on market and regulatory conditions in the United States and other nations. Many U.S. investors have established aquaculture operations in other countries in the absence of a clear regulatory regime in the United States.

Question 7. How does allowing foreign ownership contribute to the Administration's stated interest in increasing U.S. competitiveness and improving our balance of trade?

Answer. The U.S. aquaculture industry can learn from overseas companies, practitioners, and partners who, in many cases, may have greater expertise and experience in aquaculture operations. By allowing foreign participation in offshore aquaculture, we will also maintain good investment and trade relations with other nations, which may also import seafood produced by the U.S. offshore aquaculture industry. The more our domestic aquaculture businesses can produce, the greater the opportunity to reduce imports or to increase exports and reduce the almost $8 billion annual seafood trade deficit in the United States. Our challenge is to integrate aquaculture into domestic seafood production so our fishermen, processors, and seafood marketing companies can benefit directly from aquaculture.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BARBARA BOXER TO DR. WILLIAM T. HOGARTH

Question 1. What are NOAA's specific recommendations for mitigating some of the likely cumulative and individual environmental and socioeconomic effects of offshore aquaculture? Would NOAA oppose incorporating these protections into this legislation?

Answer. NOAA believes that offshore aquaculture will present benefits as well as challenges. The benefits will include more resilient coastal communities that will have another compatible option to produce seafood. These communities will benefit from the ripple effect created by expansion of local industry. S. 1195 would provide the necessary authority to require, through regulations or permit conditions, appropriate measures to avoid, minimize, or mitigate unacceptable environmental and socioeconomic impacts. The bill also provides authority to monitor operations and to take emergency actions to address unanticipated impacts in a timely manner. NOAA expects that the public rulemaking process will address specific mitigation steps in more detail.

Question 2. What are NOAA's specific recommendations for minimizing the possible human health problems surrounding the consumption of farmed fish, such as the effects of antibiotics and PCBs? Is NOAA opposed to incorporating these protections into this legislation?

Answer. NOAA's mission includes a focus on human health and safety, and NOAA seeks to maintain a positive connection between human health and seafood. Unfortunately, there is misinformation about the safety of our seafood supply and some published research has been shown to be inadequate, flawed, or biased. The issue of seafood safety requires clarification based on the latest information from leading scientists, nutritionists, and medical and healthcare professionals. Studies, including those presented at the international Seafood & Health Conference in December 2005, link seafood consumption to higher intelligence in babies and children, lower heart rates in adults, lower cholesterol, lower blood pressure, and lower body weight. As stated in Dr. Hogarth's testimony to the Subcommittee, the health benefits of eating seafood far outweigh the risks due to trace level contaminant exposure. Seafood has been scientifically shown to fight cardiovascular disease, cancer, Alzheimer's disease, and many other major illnesses.

To help clarify the issue of antibiotics and aquaculture, it is important to understand that the marine aquaculture industry in the United States has largely replaced antibiotics with vaccinations administered before fish are stocked into cages. If an antibiotic is necessary, it is applied under the supervision and prescription of a licensed fish veterinarian, and is governed by Federal legislation and regulations.

All food, including beef, chicken, seafood, grains, and vegetables, contain trace levels of persistent organic chemicals such as PCBs, because these chemicals are everywhere in our environment in very small quantities. The U.S. Food and Drug Administration regularly monitors food products—including cultured seafood—to ensure they are safe to eat.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO DR. WILLIAM T. HOGARTH

Protein Conversion Ratio

Question 1. Many of the people I talk with in Washington State are on the whole positive about aquaculture of shellfish, catfish, and other herbivorous or filter feeding species. Carnivorous species, however, are less well received—a perception that comes in large part from negative environmental and economic experiences with net pen salmon farming. I am concerned that carnivorous finfish culture, as currently practiced, creates a net-loss of ocean protein and that large scale exploitation of forage fish species used for fish meal could have profound ecosystem effects. How has NOAA encouraged or sought solutions to overcome the reliance on wild fish stocks as feed, which in many ways seems to be an Achilles heel for any large-scale carnivorous finfish aquaculture operation?

Answer. On a global scale, significant advancements have been made in reducing the reliance on fish meal and fish oil for feeds used in aquaculture, and NOAA plays a vital role in this research. For example, scientists at NOAA's Northwest Fisheries Science Center, along with scientists from other agencies and industry, are active participants in ongoing research focused on the development of alternative feed ingredients for cultured species, including finfish.

Among the most notable advancements in feeds are plant-based alternatives to fish meal and fish oil. This groundbreaking research—using soybeans, barley, rice,

peas, and other crops as alternatives—is expanding in the United States and across the globe. Other meals such as canola, lupine, wheat gluten, corn gluten, and various plant protein concentrates—many of them grown in the United States—have already been shown to be highly palatable and digestible for fish. As the price of alternative ingredients drops below that of fish meal, those ingredients will be substituted for fish meal and fish oil.

Further development of plant-based feeds also represents a huge opportunity for American agriculture, as the United States produces an abundance of high-quality proteins and fats that could be used in fish production. Increased production of high-protein by-products from bio-diesel production, and high-protein and high-fat by-products from ethanol and bio-plastics production are likely in the future. Feed experts believe these by-product meals will be ideal for fish production.

Although the amount of fish meal and fish oil in feeds will be reduced as alternative ingredients come online and the cost drops, they likely will not disappear from feed altogether. Research on plant-based oils has found that maintaining some fish oil or suitable alternatives derived from algae, for example, in fish feed is important to maintain the health benefits to humans of eating marine fish, including the long-chain Omega-3 fatty acids.

Scientists are most concerned about two healthy fatty acids—decosahexinoic acid (DHA) and ecospentanoic acid (EPA). These fatty acids are not produced by fish, but fish concentrate them in their fats from the prey they eat. DHA and EPA are made by algae and microorganisms and are passed up the food chain. These organisms can be cultured directly to produce concentrated DHA and EPA. In fact, all the DHA currently used in baby formula in the United States comes from production of micro-algae, not from fish oil. Although it is costly, experiments have shown that a small amount of this concentrated algae oil can be added to vegetable oil to restore the healthy fatty acids in the final product. In addition, other healthy fats, such as the shorter chain Omega-3 fatty acids found in olive and flax oil, can also be incorporated into the cultured fish. NOAA and other Federal agencies are working with industry on research to develop lipid substitutes, such as marine micro-algae production, to reduce reliance on fish and oils. The agencies, research institutions, and others will continue to partner with grain and feed companies and with feed researchers to find suitable alternatives for fish meal and fish oil.

From a purely economic perspective, it is also well understood that feed is a major component of the cost of production in an aquaculture operation. Typically, the cost of feed accounts for over 60 percent of operating costs, so there are strong economic incentives for the industry to help develop suitable alternative ingredients for feed formulas, and to become more efficient in converting feed into product.

Question 2. If the current bill is passed, will NOAA in any way encourage or offer incentives to operations that raise herbivorous or filter feeding organisms?

Answer. We do not intend to promote any particular type of aquaculture in the implementation of an offshore aquaculture act. NOAA plans to consider the risks and impacts associated with proposed offshore aquaculture facilities in making permit decisions. NOAA will also consider any research proposals relating to these and other types of aquaculture for possible funding under our competitive grants program, the National Marine Aquaculture Initiative.

Few truly herbivorous marine fish are of significant commercial value. The majority of herbivores in the marine ecosystem are microscopic zooplankton. Emphasizing herbivorous or filter-feeding organisms could diminish the tremendous opportunity for American agriculture to provide plant-based feed ingredients for finfish (as addressed in the previous answer) and to supply the market with marine fish that are in high demand and provide important nutritional benefits to U.S. consumers.

Regional Fishery Management Council Oversight

Question 3. S. 1195 contains specific instructions for the Secretary to "consult" with the appropriate Regional Fishery Management Council before issuing an offshore aquaculture permit. In his testimony, Mr. Vinsel insisted on more than consultation and stated that Councils should have some degree of authority throughout the process. What specifically do you see as the Councils' role in planning for a sustainable offshore aquaculture industry? Please describe the Councils' probable role in permitting individual sites and oversight of a permitting regime?

Answer. NOAA has a long-standing working relationship with the Regional Fishery Management Councils established under the Magnuson-Stevens Fishery Conservation and Management Act. S. 1195 requires NOAA to consult with the Councils in developing and implementing the regulatory regime for offshore aquaculture. NOAA would consult with the Councils in drafting implementing regulations, in the establishment of environmental and other requirements (especially as they relate to interactions with wild stocks managed by the Councils), and in the review of indi-

vidual permit applications. NOAA intends to use the rulemaking process to define the Councils' role in permitting individual sites once the bill is enacted. In the meantime, NOAA has identified opportunities to begin discussing the consultation process with the Councils on an informal basis.

Multiple Use Planning

Question 4. In an October 2005 NOAA-funded University of Delaware report titled "*Recommendations for an Operational Framework for Offshore Aquaculture in U.S. Federal Waters*" the authors recommend a multiple use planning process in order to identify suitable areas for offshore aquaculture and avoid those susceptible to environmental harm or prone to potential user conflict. According to the report, mapping, planning, or zoning activities should take place before the EEZ is offered for aquaculture leasing. If S. 1195 becomes law, will NOAA engage in such an exercise? What would such a plan look like and would it follow this report's Chapter Four recommendations?

Answer. NOAA values the recommendations provided in the University of Delaware report, which was intended to inform the policy process as we move forward with the development of offshore aquaculture. We agree on the need for comprehensive mapping of offshore areas to identify areas suitable for the offshore aquaculture industry, and we are already working with partners in several regions who are interested in completing this type of GIS mapping exercise. As we move forward with rulemaking following enactment of an offshore aquaculture act, we will consider the options proposed by the University of Delaware study for the placement of offshore aquaculture operations. These range from a case-by-case approach to the establishment of pre-permitted sites, designated areas for pilot projects, zoned areas, and marine aquaculture parks. We will seek public input on these approaches as well as the criteria to be considered in the siting of offshore aquaculture.

Legislative EIS

Question 5. Does NOAA plan on conducting a legislative EIS on S. 1195 as required by the National Environmental Policy Act of 1969? If not, please explain your reasoning. If yes, please describe the process and what it will accomplish.

Answer. NOAA acknowledges and understands the environmental, economic, and social concerns associated with marine aquaculture. NOAA agrees that these issues need to be considered as part of an evaluation of implementation of any legislation regarding offshore aquaculture. It is clear that the offshore aquaculture bill will be amended as it moves through Congress. It is also likely that the various aspects of the bill analyzed through a legislative environmental impact statement (EIS) process would change. With that in mind, NOAA does not currently plan to prepare a legislative EIS.

Question 6. Will NOAA conduct a programmatic EIS if S. 1195 becomes law? If not, please explain your reasoning. If yes, please describe the process and what it will accomplish.

Answer. Yes, NOAA will focus its efforts and resources on preparing a programmatic environmental impact statement once legislation is passed. This programmatic EIS will contain many of the same components as a legislative EIS, and will be available for full public comment.

The process will be driven as outlined in Sec. 4(d)(2) of S. 1195—Criteria for Issuing Permits. As stated in the bill, the Secretary shall consider risks to and impacts on natural fish stocks, the coastal environment, water quality and habitat, marine mammals and endangered species, and the environment.

Socioeconomic Concerns

Question 7. Please describe NOAA's process for considering the socioeconomic impacts of their actions. To your knowledge, has NOAA analyzed the potential socioeconomic impacts of offshore aquaculture development? If so, can you please provide me with copies of relevant documents? If such a study has not been conducted, will one be in the future?

Answer. NOAA is working with top social scientists and economists across the Nation to analyze the economics of marine aquaculture as it relates to commercial and sport fishing, market opportunities, global trends, underused processing capabilities, value-added niche markets, and coastal job development. The results of this analysis will be available in late 2006.

Question 8. Does NOAA have a strategy to balance or minimize the economic and social impacts of increased offshore aquaculture on fisheries-dependent communities? If so, please describe and provide me any relevant documents.

Answer. NOAA believes that offshore aquaculture will present benefits as well as challenges. As noted above, NOAA is working on a comprehensive analysis of the

economics of marine aquaculture. We anticipate that the benefits will include more jobs and more opportunities in coastal communities that can benefit from the ripple effect created by expansion of local industry. S. 1195 would provide the necessary authority to require, through regulations or permit conditions, appropriate measures to avoid, minimize, or mitigate unacceptable impacts. The bill also provides authority to monitor operations and to take emergency actions to address unanticipated impacts in a timely manner. NOAA expects that the public rulemaking process will address specific mitigation steps in more detail.

Improving the Bill

Question 9. After listening to today's testimony, I still have serious concerns about the environmental, social, and economic impacts that might result from passage of S. 1195 as it is currently drafted. Would you be willing to work with Members of this Committee to make changes to the bill so that these concerns are addressed?

Answer. Yes, NOAA is willing to work with the Committee to address specific concerns about the bill. As Dr. Hogarth stated in his oral and written testimony to the Subcommittee, NOAA views S. 1195 as a starting point, and the agency is willing to work with the Committee to address concerns about the bill as well as the amendments.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO DR. RICHARD LANGAN

Environmental Concerns, Introduced Species, and Disease

Question 1. How can we ensure the protection of wild stocks from the potential dangers of invasive species, genetic contamination, or disease?

Answer. The starting point is to be clear that systems must be designed to ensure this outcome, rather than viewing these as add-ons. Experience in aquaculture, agriculture, and other fields, all suggest that effective independent research and demonstration programs are critical in making this happen. It costs money to learn the best ways to raise fish, and early investment in developing environmentally wise approaches will pay big dividends.

At this point, I don't see the need for introducing non-native fish. There are many native warm and cold water fish that are good candidates for culture. The most effective way to protect wild stocks is to use native species that are produced from wild broodstock and genetically identical, or at minimum genetically very similar to the wild populations in the region. That way in the event that fish do escape, they will not have any negative impact on wild stocks. This is the approach we have followed in our demonstration project.

It would be unwise to absolutely rule out the culture of non-native fish. But doing so depends on two factors. One is the development and demonstration of systems that are highly reliable over extended periods. The other is to put in place procedures that ensure careful consideration of all potential impacts of escaped fish before allowing the culture of non-natives.

Disease is a very serious issue and disease management is at the top of the list of concerns for fish husbandry. While there has been a lot of discussion about the potential for diseases and parasites to be passed from farmed fish to wild fish, it is very important to remember that diseases and parasites also can be passed from wild to farmed fish. In the past decade, the aquaculture industry has made good progress in developing vaccines and this trend should continue. Salmon farmers have been able to reduce the use of antibiotics by more that 99 percent during the same time that production has increased by 300 percent. Good fish health is also achieved though good nutrition and low stress levels, so we need to provide the right feed in the right amounts and create low stress environments for the fish. Fish farmers routinely develop and implement biosecurity plans for all phase of culture that include inspection for potential signs of disease and prescribed actions should an incident occur.

As with all other aspects of aquaculture, consistent maintenance of fish health needs to be designed into operating systems from the outset, not viewed as a reaction-based treatment issue. Our project has invested significant sums in innovative monitoring systems, such as real-time video monitoring of cages and electronic tagging of specific fish, in order to identify ways of designing systems that maximize the right outcome—healthy fish. To cite but one small example, our work with cod revealed an unexpected tendency to crowd into any available distant corner rather than utilize open spaces. This has implications for fish cage design, and ultimately fish health.

Question 2. What kind of environmental safeguards have effectively addressed public concerns about these and other environmental problems?

Answer. There have been many lessons learned over the past two decades of nearshore aquaculture expansion here and abroad. Many pollution issues can be addressed through proper siting of farms and responsible farm management. Insuring adequate dispersion of fish wastes by locating farms in areas with sufficient water circulation and carefully monitoring fish feeding behavior with video cameras in the cage so that food is not wasted can significantly reduce accumulation of organic materials on the seafloor. It should be noted that waste from farmed fish is not the same as, nor does it pose any of the human health risks as human sewage or swine wastes. It is in fact, identical to waste from wild fish. The ocean has been assimilating fish wastes for millions of years and as long as too much isn't concentrated in one place, there is no harm done to the environment.

Coupled with siting and farm management, there must be scientifically appropriate environmental standards and monitoring programs to insure that these standards are met. There are a number of good examples to draw from. The States of Maine, Washington and Hawaii have established good environmental standards, as have Norway and the European Union. There is a recently published multi-author document entitled *Recommendations for an Operational Framework for Offshore Aquaculture in U.S. Federal Waters* that was produced by Center for Marine Policy at the University of Delaware. This document provides guiding principles and specific provisions for leasing and permitting of aquaculture facilities, site planning and assessment, potential environmental ramifications and steps to mitigate them, and proposed monitoring strategies for facilities raising native fish, shellfish and seaweeds. This document and the U.S. State and European programs can be used as model guidance for offshore development.

The use of fishmeal and fish oil for formulated feeds is often cited as a major environmental issue for aquaculture development. It certainly is true that we need to continue to do research on developing alternative protein and lipid sources for fish. However, it should be recognized that when this issue is raised, it is usually done so without the proper context. Fishmeal and oil are produced from several species of small, short-lived fish that are rarely consumed by humans. The primary fishery that supports the global fishmeal supply is the anchovy fishery off the Pacific coast of South America. It is one of the best-managed fisheries in the world and catches have been stable for more that two decades.

Perhaps more important, however, is the fact that aquaculture currently uses about 30 percent of the fishmeal supply; the remaining 70 percent is fed to poultry and swine. Fish are several times more efficient in converting fishmeal protein into edible flesh than both poultry and swine. Because of this conversion efficiency, it is likely that a greater percentage of fish meal will go toward feeding fish in the future. It is, however, a finite resource, therefore, we must continue to conduct research into alternatives to fishmeal if we wish to vastly increase our aquaculture production. Just as we cannot rely on wild caught fish for all of our seafood requirements, so too we cannot rely on wild caught fish for feeding captive fish.

Question 3. What are realistic expectations of what aquaculture can do for the United States to improve our economic returns, food supply, and balance of trade?

Answer. In 1999, the Department of Commerce released an initiative to increase domestic aquaculture production from a $1 billion to a $5 billion dollar per year industry by 2025. This is an ambitious goal that will require substantial new development. Some increases can be gained through expansion of nearshore and land-based culture, however, expansion to this scale will require significant offshore development. We may not entirely reverse the trade deficit by 2025, but if we are successful in developing offshore farms, U.S. consumers will have much greater access to high-quality domestically-produced seafood to the benefit of the local and regional economies. It should be recognized, however, that this is unlikely to happen without public sector investment into research and technology development and demonstration so that operational, economic and environmental risk is well understood by practitioners and regulatory bodies.

Question 4. How much growth can we reasonably expect for the U.S. offshore aquaculture industry with all the competing uses of our coastal areas, particularly when combined with our need to provide adequate protection for wild stocks, environmental conditions, and—of course—the people who have to live with the choices?

Answer. There are certainly many competing uses in the ocean and areas that are environmentally sensitive that need to be protected, however, the actual production space needed to produce $5 billion worth of seafood annually is about 350,000 acres, or about 0.01 percent of U.S. EEZ waters. It is essential that we move well offshore, rather than trying to do too much in the heavily utilized nearshore areas. Our

project is about six miles offshore, and utilizes cages that are totally submerged. There are substantial engineering challenges in developing viable, secure systems for operating in the open North Atlantic Ocean. However, we are showing that it can be done. Provided that we are willing to invest what it takes to do this right, then it should be feasible to successfully operate such systems far offshore. And by "successfully", I mean with containment systems that meet all of the standards needed to ensure successful growing of fish, and also protection of wild stocks and the environment. With offshore aquaculture, the big choice involved is to commit ourselves to doing it right, designing it for success, and designing it to be environmentally friendly. Done right, it is entirely possible to locate farms at this scale such that user conflict is avoided and environmental impact is minimized.

Public Outreach

Question 5. There have been many concerns raised in local communities about the effects of offshore aquaculture. Many feared that they would lose access to productive fishing grounds or that areas that were once public would become private. Mr. Cates mentions that many concerns were raised by the communities—some that were valid and some that were not questions.

Many on this Committee are concerned about the effects of offshore aquaculture on local communities which rely on the sea for income from tourism and other uses. Please tell us about how we can work with local communities to address their concerns and to involve them effectively in the decisionmaking process.

Answer. Aquaculture needs local community support to succeed. I believe that Mr. Cates and Mr. Sims from Kona Bluewater were successful in obtaining permits for their offshore farms because they engaged the local communities to hear and respond to their concerns. They designed and now operate their farms in way that benefits rather than impacts the social and economic fabric of local communities. I believe this approach is the proper one, and that local communities must have a voice. Public venues, whether they are informal events organized by the entrepreneurs or required by the regulatory process, are an important component of the permitting process. Convening meetings with local fish cooperatives and associations are also another way to engage the community.

I also believe that the public should be provided with third party, independent, and scientifically valid information on the costs, benefits, and potential impacts (economic, environmental) of aquaculture. We must find some way of providing unbiased information to local communities so they can decide for themselves what is best. There are many scientists and extension educators in the fields of biology, public health, and environmental studies, as well as economists and social scientists that are capable of providing unbiased information. I believe their services should be enlisted to provide information that is backed by scientific fact.

Question 6. What are some of the valid concerns and lessons learned at the state and local level that we can apply to this Federal process?

Answer. I have addressed some of the concerns such as proper siting in my answers to previous questions, and determining the right location for farming operations is certainly an important first step in avoiding user conflict and potential environmental impacts from fish wastes. This requires the informed input of the local resource users (fishermen, boaters, whale watchers, environmentalists, commercial industry, etc.), and knowledge of physical and biological oceanographic conditions. Baseline knowledge of the local ecosystem is important in order to select the appropriate environmental indicators and to set environmental standards. The proposed infrastructure (e.g., cages and moorings) should be carefully evaluated by knowledgeable individuals to insure the equipment is appropriate for the oceanographic conditions at the proposed location. Operator qualifications and management plans for operations, biosecurity and containment should also be evaluated by experts.

Question 7. Which groups and issues should we be sure to include?

Answer. Potential user and cultural conflict can be assessed by engaging local and regional resource users, and knowledgeable and unbiased engineers, environmental and social scientists, and economists can provide informed assessments of the viability and anticipated economic, social, and environmental impacts of proposed operations. NOAA should also consult with state and Federal agencies charged with enforcement of statutes that may be affected by proposed operations.

Question 8. Is there a model process used in other permitting schemes that could be incorporated into legislation for offshore siting of aquaculture?

Answer. A number of states, including Maine, Washington and Hawaii, have developed permitting processes that include engineering, environmental and economic evaluation, as well as opportunity for public input. While they may not work perfectly in all cases, their frameworks are applicable to offshore permitting and can

be used as a starting point. Norway and the European Union have also developed permitting processes that balance economic development with protection of natural and cultural resources, and have established appropriate environmental standards for farm operations. The document I mentioned earlier that was published by the University of Delaware also contains relevant information about the permitting process.

Massachusetts has developed Geographic Information System (GIS) mapping inventories of their nearshore waters that include natural and cultural resources, human activities such as fishing grounds, shipping lanes, recreational areas and aquaculture sites. A similar approach can be taken with offshore waters. With the additional of tools such as physical and biological oceanographic modeling, remote sensing and ocean observing, similar mapping resources can be developed to identify both appropriate and inappropriate locations for siting offshore farms.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. OLYMPIA J. SNOWE TO DR. RICHARD LANGAN

Research and Development

Question 1. The Open Aquaculture Program at the University of New Hampshire is making great strides in research and development of offshore aquaculture operations in New England, and you have unique insight into the technical, economic, and ecological feasibility of such an industry. And you know, perhaps better than most, exactly what further research is needed to develop the industry. The administration's bill does include, in Section 6, language authorizing a research and development program, but it is somewhat vague and open-ended in its proposal.

Could you please elaborate on how you think the bill's section on research and development could be improved? Right now, is the language specific enough to authorize the research and development program you describe in your testimony?

Answer. First, I'd like to thank Senator Snowe for the opportunity to comment on this aspect of the Bill. The discussions that followed the witness testimony at the hearing on April 6 did not address the topic of R&D.

I agree that the language as currently written is vague. Coupled with the history of minimal Federal financing for marine aquaculture, the language offers little assurance of the kind of effort needed to successfully establish a well-designed offshore aquaculture industry.

Building on what I described in my written testimony, I would suggest that this section be restructured to achieve the following:

- Include the designation of regionally relevant centers and demonstration projects and a comprehensive and strategic competitive, peer-reviewed national program for funding R&D.
- Engage the services of technology transfer professionals to link practitioners with the most recent advances in science and technology.
- Be very similar to the USDA model for agriculture industry sectors and would be a collaborative effort between the Federal Government led by NOAA, and appropriate research institutions in the regions.
- Include specific features like SBIR and STTR funding from SBA to foster innovations and startups.
- Engage State Sea Grant/Cooperative Extension Programs for outreach.

Some of these components are already in place. NOAA has a small but effective national marine aquaculture competitive program based at the National Sea Grant Office in OAR. Unfortunately, this program has received little or no funding in the past, severely constraining the potential impact of the research it supports. In addition, the Sea Grant program has funded some marine aquaculture activities over the years. Finally, each state Sea Grant program has extension agents that connect local and regional stakeholders to research results. This program could be strengthened and expanded to lead technology transfer efforts for offshore development.

There are currently three regional centers either in operation or in development, ours in the Northeast, and centers in Hawaii and the northern Gulf of Mexico. Formal designation and consistent funding of these three and perhaps others in the future would provide the stability needed to integrate research findings, demonstrate and evaluate technologies, and conduct environmental and economic assessments. These three centers are already working as envisioned and are places where integrative research or broad utility can occur that benefits many open ocean aquaculture sectors (e.g., fin fish, shellfish, specific regional stock culture).

Translating this response into a specific suggestion, I might offer the following, using the proposed National Aquaculture Act as a starting point. Add a new subsection to Section 6, as follows:

(c) The research program shall include, at a minimum, the following elements—

(1) At least three regional Marine Aquaculture Centers operating sites for research, development, and demonstration of innovative and best practice technologies,

(2) A national competitive research program, and

(3) Regional competitive research programs managed by or in cooperation with the Marine Aquaculture Centers.

Question 2. How should NOAA set research priorities for this program? Would you advise us to direct research toward certain topics, or should we allow NOAA develop its own criteria for pursuing research?

Answer. Ideally, setting research priorities should be a collaborative effort between NOAA, the research community, the practitioners, nongovernmental organizations (NGO's), and representatives from the states. One such example is important to highlight as it is already a model for a national integration system. On behalf of our center, I have proposed to NOAA a process in which the regional centers, in collaboration with NOAA, engage stakeholders to develop regional priorities. The centers and NOAA can then come together to share regional findings, set national priorities, and develop a comprehensive R&D strategy for a five-year period, and set performance measure to evaluate success. NOAA and the regional centers would then meet annually to evaluate progress and adjust the research strategy as needed.

Question 3. How much funding should Congress authorize for this research and development program?

Answer. The amount the government should invest in R&D should be commensurate with the goal (a $5 billion offshore industry by 2025) and the size of the problem (an $8 billion trade deficit). I would think $50 million per year over a five-year period would be the minimum amount needed to begin to have the desired impact. This amounts to an investment each year equivalent to 1 percent of the $5 billion industry goal. Typically, R&D and technology transfer expenditures in a new business area would be much higher (>10 percent), but the figure I suggest reflects the budget realities for the current Federal budget and for NOAA at this time.

We should also take a careful look at what the investments by foreign governments (*e.g.,* Ireland, Norway, Japan and South Korea) have yielded for their aquaculture industries as a measure of what would be needed.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARIA CANTWELL TO DR. RICHARD LANGAN

Question. From your research, do you think that herbivorous or filter-feeding organisms can be profitably raised in the EEZ, or is offshore aquaculture likely to be dominated by carnivorous species such as salmon, black cod, and halibut?

Answer. We have had great success in developing offshore technologies, operational methods, and business planning tools for producing high quality filter feeding shellfish (blue mussels) in New England. Our research has led to a commercial venture that if successful, could lead to a thriving regional industry and an important business opportunity for underemployed commercial fishermen. These technologies could be adapted for use with filter feeders indigenous to other regions of the country. Farms for filter feeders can be operated independently or in conjunction with fish farms to balance the addition of nutrients from fish feeds by removing suspended particulates and algae that grow in response to nutrient additions.

Regarding your question about herbivorous fish, most marine fish that are palatable to humans are carnivores and require a high protein diet, which for most species now requires the use of fishmeal in order to meet their nutritional requirements. There has been some success in substituting vegetable proteins for some of the fishmeal, however for some marine fish, vegetable proteins like soy meal in its current form contain anti-nutritional factors. Further research on the properties of soy may solve these problems, however, research on proteins from other plants such as seaweeds should continue as well.

The use of fish meal and fish oil for formulated feeds is often cited as a major environmental issue for aquaculture development, and I agree that we need to continue to do research on developing alternative protein and lipid sources for fish. However, it is important that we address this issue in the proper context. Fishmeal and oil are produced from several species of small, short-lived fish that are rarely

consumed by humans. The primary fishery that provides the global fishmeal supply is the anchovy fishery off the Pacific coast of South America. It is one of the best-managed fisheries in the world and catches have been stable for more that two decades. Aquaculture currently uses about 30 percent of the fishmeal supply; the remaining 70 percent is fed to poultry and swine. Fish are several times more efficient in converting fishmeal protein into edible flesh than both poultry and swine and because of this conversion efficiency, it is likely that a greater percentage of fish meal will go toward feeding fish in the future. It is, however, a finite resource, therefore, we must continue to conduct research into alternatives to fishmeal if we wish to vastly increase our aquaculture production.

Your question does highlight an important benefit from a substantial, creative research and development program. Industry necessarily focuses on the easiest, most profitable opportunities. However, there are always potential activities that warrant exploration. Some degree of ongoing investment in a wide variety of environmentally advantageous species is needed. For example, we have explored sea scallops, others at my university are working with sea urchins, and we are interested in such things as seaweed. Clearly, profitable culture of various filter feeders would open the way for environmentally beneficial development. From an industry perspective, these are not obvious candidates for investment, however, so the only way we can get them to that point is through methodical research and demonstration.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO JOHN R. CATES

Fish Escapes, Introduced Species, and Disease

Question 1. Although you use native fish in your farms, some believe even native fish escapes may have negative impacts on wild populations. Have you experienced escapes at any of your facilities?

Answer. We have not had any escapes on our site. In my opinion is due to the type of cage and gear that we use, all of which is submerge 40 feet below the surface.

Question 2. What are the specific concerns in Hawaii about non-native species as well as escapes?

Answer. The issue on non-native species as well as escapes has been addressed here in Hawaii several years ago when we developed our Ocean Leasing policy. The policy clearly states that we can only use native species. Our fish are the same as what are being used for stock enhancement.

Question 3. Are there concerns about genetic contamination?

Answer. The issue of genetic contamination has also been addressed, our leasing law states that we use wild broodstock, thus our fingerlings are F1 generation which addresses this issue.

Question 4. What preventative measures can be taken to avoid this from happening?

Answer. As stated above, if we use only native fish this issue goes away. Alaska has the most experience with this issue, that state releases millions of fingerlings into the wild every year. This issue can be managed properly.

Question 5. Are you using sterile fish to eliminate this concern?

Answer. No, we do not use sterile fish.

Question 6. What research is necessary to answer these questions?

Answer. More research could be done, but I believe we already have enough information on this issue to do it safely, Alaska is a good example. Though many in Alaska state that they have banned aquaculture, in fact, that state has the most production from hatcheries and release them into the wild every year.

Environmental Concerns, Introduced Species, and Disease

Question 7. How can we ensure the protection of wild stocks from the potential dangers of invasive species, genetic contamination, or disease?

Answer. If we follow the above examples, we can proceed safely. Man has for a very long time been affecting the genetics of our fisheries. The policy of keeping bigger fish and releasing smaller fish has had an impact on the genetics of the population. The new technologies in fishing can now catch entire schools of fish in large scale operations which affect the genetics.

Question 8. What kind of environmental safeguards have effectively addressed public concerns about these and other environmental problems?

Answer. Once again, if we follow similar policies that both Hawaii and Alaska have developed, we can proceed safely. Hawaii has developed ocean farming, and

Alaska has developed hatcheries and releasing them into the wild. Much work has been done on the genetics with salmon and this issue.

Question 9. What are realistic expectations of what aquaculture can do for the United States to improve our economic returns, food supply, and balance of trade?

Answer. Aquaculture can achieve two different things, first, it can start to fill the gap with the shortfall from our wild fisheries. Every year, more and more closures, and less production from our wild resources. Second, it can raise awareness with the public about the state of our fisheries, and the need to act responsible and grow our seafood as we do with all other protein sources.

Question 10. How much growth can we reasonably expect for the U.S. offshore aquaculture industry with all the competing uses of our coastal areas, particularly when combined with our need to provide adequate protection for wild stocks, environmental conditions, and—of course—the people who have to live with the choices?

Answer. This is a very difficult question because growth depends on the political status of each area, many will always say "not in my back yard." But for potential, I like to use the fact that in Norway, they have over a billion dollar industry, and the square footage footprint of all of the fish cages would fit on any large airport runway in the U.S. It is not a very large area when compared to the ocean.

Public Outreach

Question 11. There have been many concerns raised in local communities about the effects of offshore aquaculture. Many feared that they would lose access to productive fishing grounds or that areas that were once public would become private. Mr. Cates you mentioned that many concerns were raised by the communities—some that were valid and some that were not.

Many on this Committee are concerned about the effects of offshore aquaculture on local communities which rely on the sea for income from tourism and other uses. Please tell us about how we can work with local communities to address their concerns and to involve them effectively in the decisionmaking process.

Answer. In our experience, many have benefited from our operations, fishermen routinely use our site to assist them with commercial fishing, and we are a good source for their bait. Also dive operations continually asked to use our site as a popular dive location. But to answer this in a better manner, once we as a society make the commitment to grow our food, we will find the right locations. Our site would not be appropiate to locate off of Waikiki, but off of Ewa Beach, 2 miles out, we have had no conflicts.

Question 12. What are some of the valid concerns and lessons learned at the state and local level that we can apply to this Federal process?

Answer. Each community must have a voice and choice in this. Also each new company should have community acceptance, and also each community should be respectful of change. Also, I feel strongly that each new company trying to conduct this business, should have to prove that it is capable of conducting such an operation in a safe manner for both the environment, and for its personnel.

Question 13. Which groups and issues should we be sure to include?

Answer. Each area will be different, but for Hawaii, we need to include native Hawaiians, fishermen, and all ocean users. In my case, I did all of the above and more, but also I used our Kupuna's Knowledge to assist me in my siting and operations. There is valuable information out there, we just need to be respectful and ask for it.

Question 14. Is there a model process used in other permitting schemes that could be incorporated into legislation for offshore siting of aquaculture?

Answer. I am not sure, but for Hawaii, it has worked very well thus far, and not everyone that has tried has been successful.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARIA CANTWELL TO JOHN R. CATES

Question. Mr. Cates, I understand that a 3 to 1 feed conversion ratio for carnivorous finfish culture is fairly typical—that is, it takes 3 pounds of wild caught fish to produce one pound of farmed fish. Could you please tell me what the feed conversion ratio is for your aquaculture operation? Are you or others working on improving your operation's feed conversion ratio?

Answer. I do not believe that the feed conversion ratio that was stated is correct. I have for years heard so many different numbers being used, but I can tell you for a fact that on our operation we have been and are achieving numbers lower than 2 to 1. Salmon farming is even lower. But you must remember that the feed that

I use is 60 percent wheat and soy bean, and only 40 percent is fish meal. There are solutions to the fish meal issue, but it doesn't make sense to me that as a society we feed fish meal to chicken, pork, and cattle with not much concern, but when we use it in fish feed, all of a sudden we are committing some sort of sin. We need to have a more balanced approach to this issue, and to all of our fisheries.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO MARK VINSEL

Environmental Concerns, Introduced Species, and Disease

Question 1. How can we ensure the protection of wild stocks from the potential dangers of invasive species, genetic contamination, or disease?

Answer. For wild stocks to be protected from risks of invasive species and genetic contamination, permits should not be issued for the farming of any species that is not indigenous to an area, and if the farming of species that occur naturally is to be considered, then natural local stocks should be used.

To protect from the possibilities of disease transmission, fish should not be raised in concentrations that exceed the natural population distributions for fry and juvenile fish, or after assessment, do not risk exceeding ocean carrying capacities identified as being necessary to the well-being and productivity of local fish populations. Fish farms should not be located in areas where natural fish occur.

Question 2. What kind of environmental safeguards have effectively addressed public concerns about these and other environmental problems?

Answer. Offshore finfish farms have not adequately addressed these environmental problems. A recent report on a finfish farm operation in Hawaii suggests that the presence of fish farming has caused diminished species diversity and eutrophication. We feel that large scale finfish farms cannot help but pose unacceptable risks to naturally occurring fish populations in the area.

> (Lee, Han *et. al* "temporal Changes in the polychaete infaunal comminuty surrounding a Hawaiian mariculture operation" *Marine Ecology Progress Series,* Vol. 307. pp 175–185, January 2006—for abstract see: *http://www.int-res.com/abstracts/meps/v307/p175-185/*)

Question 3. What are realistic expectations of what aquaculture can do for the United States to improve our economic returns, food supply, and balance of trade?

Answer. We see little help available in the domestic seafood food supply or balance of trade. While increased volume of fish may occur, environmental problems that they bring suggest to us that the fish farm production will create a significant cost to existing seafood production.

Regarding the seafood balance of trade, costs of domestic production will necessarily include wages and environmental standards concurrent with U.S. standards, which history indicates will be undercut by foreign producers. If domestic production of high volumes of fish were to occur, prices for U.S. wild and farmed raised fish would likely suffer, eroding any net economic gain.

Alaska's coastal communities rely on the local fishing economy to a high degree. Many of these communities do not have the basic infrastructure that most U.S. citizens take for granted to support alternate business. A good example of the economic problems caused by fish farms is shown in the price of salmon during the 1990s to the present, as foreign salmon farms proliferated. Operations initially produced fish at approximately $4 per pound, and were planned to be profitable at that price. Production in excess of market demand soon caused a drop in price, even of foreign farmed fish, to around $2 per pound, and at this price point the foreign fish farms were no longer profitable, and domestic producers and communities were devastated by the impacts on domestic wild salmon prices. Salmon farm businesses are not the profitable business ventures they were projected to be, and consolidation is occurring that is moving ownership away from local businesses to foreign corporations.

Meanwhile in Maine, wild Atlantic Salmon are nearly extinct and have suffered from diseases and escapes from salmon farm operations.

Question 4. How much growth can we reasonably expect for the U.S. offshore aquaculture industry with all the competing uses of our coastal areas, particularly when combined with our need to provide adequate protection for wild stocks, environmental conditions, and—of course—the people who have to live with the choices?

Answer. The projections of $5 billion, compared to current domestic wild fisheries ($4 billion?) is a grossly optimistic expectation. If finfish farms, under the current levels of technology were to reach that high level of production, it would necessarily come with some diminishment of current domestic seafood production. The push for fish farms seems more likely to shift the economic benefits from current wild catch

industry to new fish farm corporate businesses, with no net economic benefit to the country as a whole, and also putting at risk the general health of our oceans.

Public Outreach

Question 5. There have been many concerns raised in local communities about the effects of offshore aquaculture. Many feared that they would lose access to productive fishing grounds or that areas that were once public would become private. Mr. Cates mentions that many concerns were raised by the communities—some that were valid and some that were not.

Many on this Committee are concerned about the effects of offshore aquaculture on local communities which rely on the sea for income from tourism and other uses. Please tell us about how we can work with local communities to address their concerns and to involve them effectively in the decisionmaking process.

Answer. A public process is needed with meaningful local community and stakeholder input, under the overriding guidance of state-of-the-art science, with attention also given to the local and wider economic effects on other users of the ocean resources and participants in competing markets.

Question 6. What are some of the valid concerns and lessons learned at the state and local level that we can apply to this Federal process?

Answer:

Do not raise finfish in net pens.

Do not disrupt existing markets through production in excess of market demand.

Do not bring polluting enterprises to oceans.

The model of Alaska's aquaculture associations may be suitable for helping to restore populations of diminished local stocks. If aquaculture were to be conducted with the intention of helping in the rebuilding of stocks, it may well be welcomed by local communities. It may be possible to conduct ocean ranching operations to raise fry or fingerlings then release them, avoiding the long-term cumulative enegative environmental effects. With thermal otolith or other genetic markings, and sampling of catch among commercial and sport fishing communities, it may well be feasible to allow compensation of the producers to allow profitable ventures with fewer of the negative effects.

Question 7. Which groups and issues should we be sure to include?

Answer:

Commercial fishermen
Fisheries Scientists
Market economists
State fisheries management
Federal fisheries management
Seafood processors
Aquatic environmental organizations
Coastal community representatives
Large and small business representatives interested in developing offshore aquaculture

Issues:

1. Biological relationships and physical ocean impacts on potential aquaculture sites.

2. Economic integration with existing local industry and impacted communities, both in immediate region and in the global markets.

Question 8. Is there a model process used in other permitting schemes that could be incorporated into legislation for offshore siting of aquaculture?

Answer. We feel that the North Pacific Fishery Management Council is the closest thing we have to an appropriate body for permit authority over offshore aquaculture permitting. A standing committee on offshore aquaculture, tied to a Science and Statistical Committee, with ongoing economic analysis, would fit within the existing council process and should be required.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO REBECCA GOLDBURG, PH.D.

Environmental Concerns, Introduced Species, and Disease

Question 1. How can we ensure the protection of wild stocks from the potential dangers of invasive species, genetic contamination, or disease?

Answer. Congress should require that NOAA ensure that the risks posed by escapes and disease are evaluated prior to issuing site and operating permits which meet a legal standard of negligible risk to marine life.

Escapes of farmed fish from native species that are not more than two generations removed from local, wild populations "local fish" should generally pose negligible risk (except possibly from disease—see below). Congress should create strong incentives to raise such fish by creating a two-tiered regulatory process which requires stringent regulatory review for permits to raise "non-local" fish, including completion of a qualitative or quantitative risk assessment that provides strong and convincing evidence that raising "non-local" fish poses negligible risk to marine life. In addition, Congress should create accountability for fish escapes by requiring that all "non-local" farmed fish be marked, or otherwise identifiable, so that they can be traced to their farm of origin should they escape.

Both native and non-native farmed fish can potentially introduce or magnify diseases (including parasites) and spread them to wild fish populations. Preventing disease and ecological impacts from disease is best accomplished through a suite of measures—use of specific pathogen-free stocks, use of vaccines (when available), disease monitoring, moderate stocking densities, siting facilities away from wild fish aggregations, fallowing sites, and more. Congress should require that NOAA develop guidance on preventing the occurrence and spread of disease, including emergency responses to disease outbreaks, and that all applicants be required to develop a fish health plan consistent with the guidance to be enforced as a condition of a farm's operating permit.

Congress should also stipulate that operating permits for farms require reporting to NOAA of fish escapes of disease incidence, and that this information be available to the public. Not only do escapes and disease potentially affect public resources, but the potential for public scrutiny should act as an incentive for escape and disease prevention.

Question 2. What kind of environmental safeguards have effectively addressed public concerns about these and other environmental problems?

Answer. To date, none have successfully addressed the suite of concerns about marine net cage aquaculture. Coastal salmon farming—the primary model for offshore aquaculture—continues to be dogged by environmental problems.

However, there are some instances where environmental measures are helping to address specific problems associated with marine aquaculture:

In response to concerns about rising antibiotic use, the Norwegian government and salmon farmers developed vaccines for common bacterial salmon diseases, which have sharply reduced the use of antibiotics in the production of Atlantic salmon in much of the world.

In response to concerns about the genetic impacts of farmed Atlantic salmon on endangered, wild Atlantic salmon, the State of Maine is now requiring that farmed fish be of local genetic origin and be marked (so farms are accountable for any escapes).

Question 3. What are realistic expectations of what aquaculture can do for the United States to improve our economic returns, food supply, and balance of trade?

Answer. Aquaculture can provide jobs to U.S. communities, but it is probably unrealistic to expect that U.S. marine aquaculture production will make a major difference in the U.S. balance of trade in seafood. Projects to train individuals in fishing communities as shellfish producers, for example, have helped provide income to local communities. However, labor and other costs in the United States make it difficult for many aquaculturists (*e.g.,* tilapia producers) to compete with producers abroad. In the case of offshore aquaculture, technology developed in the United States to produce marine finfish may be taken to countries where fish can be produced more cheaply and easily near shore—where facility and transportation/energy costs are lower than in offshore locations. The one exception may be Hawaii, which as a volcanic archipelago has open ocean conditions in nearshore, state waters.

It is important to recognize that all the U.S. open ocean fish farms built to date have had some type of public subsidy (for example, production in publicly-financed hatcheries of fish to stock farms). It remains to be seen whether offshore aquaculture in the U.S. can be competitive in world markets.

Question 4. How much growth can we reasonably expect for the U.S. offshore aquaculture industry with all the competing uses of our coastal areas, particularly when combined with our need to provide adequate protection for wild stocks, environmental conditions, and—of course—the people who have to live with the choices?

Answer. As in my answer to Question 3 above, a major factor limiting growth of U.S. offshore aquaculture will almost certainly be lower costs in other countries, including the ability to farm fish near shore. Nearshore production in the United States is of course possible, but subject even more than offshore aquaculture to concerns from competing users of public waters.

Offshore aquaculture finfish production may also be limited by feed prices. The marine finfish species targeted for production are almost all carnivores, and thus have diets high in fish meal and oil made from wild caught fish. Until and unless new, inexpensive alternative feed ingredients are developed, booming global demand for fish meal and oil (which are used in feed for terrestrial animals as well as fish) may result in high feed prices and favor production of freshwater herbivorous and omnivorous fish, such as tilapia and catfish, which do not receive large amounts fish meal and oil in their diets.

Public Outreach

Question 5. There have been many concerns raised in local communities about the effects of offshore aquaculture. Many feared that they would lose access to productive fishing grounds or that areas that were once public would become private. Mr. Cates mentions that many concerns were raised by the communities—some that were valid and some that were not.

Many on this Committee are concerned about the effects of offshore aquaculture on local communities which rely on the sea for income from tourism and other uses. Please tell us about how we can work with local communities to address their concerns and to involve them effectively in the decisionmaking process.

Answer. It is essential that any bill to pursue the development of offshore aquaculture include provisions requiring public notice and comment for all permitting decisions, including the opportunity for public hearings. The permitting process must also be transparent, so that public participation can be meaningful. Information in submissions to NOAA relevant to evaluating the environmental impact of facilities must not be allowed to be held as confidential business information or trade secrets. Otherwise the public may not have access to information critical to decisionmaking about public waters.

Question 6. What are some of the valid concerns and lessons learned at the state and local level that we can apply to this Federal process?

Answer. One lesson is the importance of a credible and comprehensive permitting process. The Texas shrimp farming industry provides a good example. In the mid-1980s through early 1990s, shrimp farms sprouted along the south Texas coast in response to a lucrative market for shrimp and state encouragement. Among other things, the Texas State government exempted shrimp farms from discharge permit requirements as an incentive for development.

The shrimp farming industry quickly became unpopular with coastal homeowners and recreational and commercial fishermen. Shrimp farms were discharging into the Laguna Madre—a coastal estuary—about 10 to 20 percent of their pond water every day. The result was clearly visible water pollution and offensive odors. Moreover, viral diseases of shrimp ravaged many of the farms, and commercial shrimp fisherman feared that the viruses would infect local shrimp population.

In the mid-1990s, grassroots organizations, Environmental Defense's Texas office, and local governments such as the Aransas County Commissioners, all joined together to press lawmakers and agencies for changes in shrimp farm practices and regulation.

The upshot of this activity was that in the late 1990s a new law and agency actions created a new framework for environmental regulation for Texas coastal shrimp farms. These new regulations, coupled with the realization by shrimp farmers themselves that their large water intakes and discharges were contributing to their problems with shrimp viruses, led to major changes in shrimp farm practices. Most farms now only discharge water at harvest, all settle or filter water before discharge, and there have been no recent outbreaks of shrimp viruses.

Texas shrimp farming is no longer highly controversial. And, Environmental Defense recommends Texas farmed shrimp as an environmentally-preferable seafood choice for consumers.

Question 7. Which groups and issues should we be sure to include?

Answer. Commercial and recreational fishing organizations as well as conservation organizations are currently particularly interested in offshore aquaculture legislation. However, all interested groups should be able to participate in NOAA deci-

sionmaking about offshore aquaculture. As in my answer to Question 1, a transparent public process is essential.

Along with key environmental issues (water pollution, fish escapes, disease, feed), the Committee may wish to include issues concerning the socioeconomic impact of offshore aquaculture development. For example, what are the consequences of fostering greatly increased production of fish for which there is already a profitable commercial fishery? One recent study by a Canadian economist suggests that large scale fish farm development may significantly lower prices, hurting fishermen and ultimately aquaculturists. Consumers would benefit, but if most fish are exported (*e.g.,* to Japan), these benefits may accrue abroad. See *www.fisheries.ubc.ca/publications/reports/report13_3.php*

Question 8. Is there a model process used in other permitting schemes that could be incorporated into legislation for offshore siting of aquaculture?

Answer. The California legislature on May 11, 2006, passed the Sustainable Oceans Act (S. 201), which if signed into law by the Governor, will establish the most comprehensive environmental standards in the Nation to guide the growth of the marine aquaculture industry.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. OLYMPIA J. SNOWE TO REBECCA GOLDBURG, PH.D.

Fish Health and Environmental Impacts

Question 1. I understand your concerns with the potential environmental impacts that could result from poorly regulated offshore aquaculture. Aquaculture could certainly affect surrounding waters, just as the quality of waters could affect the suitability of offshore aquaculture sites. This argues for a great deal of coordination in managing and monitoring offshore habitats.

What is the best way to achieve coordination in managing and monitoring offshore habitats? How should NOAA work with states, other Federal bodies, industry, and other organizations on environmental quality and fish health on an ongoing basis?

Answer. Ideally an offshore aquaculture system would operate within a broader offshore regime that minimized conflicts and meet environmental and economic objectives, including those of conservationists and fishermen. The U.S. Commission on Ocean Policy and the Pew Oceans Commission both made a number of recommendations which could help Congress create a larger framework for ocean governance which includes offshore aquaculture development.

Question 2. Can you elaborate on how you think the non-governmental organizations—including the scientific community and public interest groups—should be involved throughout the regulatory process?

Answer. The establishment of a scientific advisory committee, which includes scientists who specialize in aquaculture, marine conservation, and fisheries science, as well as scientists from the public interest community, should make a regulatory process more credible.

Question 3. Based on the environmental concerns you outline in your testimony, do you think it would be better to forgo Senate action on this bill altogether—even if this means maintaining the status quo, allowing offshore aquaculture to proceed without any regulatory framework in place?

Answer. I urge Congress to forgo passage of S. 1195, given its numerous deficiencies, as discussed in my written testimony. Even without passage of this legislation, offshore aquaculture facilities are subject to permit requirements under the Rivers and Harbors Act, administered by the Army Corps of Engineers, and the Clean Water Act, administered by the Environmental Protection Agency. Operation of an offshore aquaculture facility may also require amendment of applicable Fisheries Management Plans under the Magnuson Stevens Act, as administered by NOAA. This existing regulatory structure is problematic, but prevents unfettered development. There is no need for Congress to rush to pass offshore aquaculture legislation, especially if it means passing legislation without careful consideration of the associated issues and policy alternatives.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARIA CANTWELL TO REBECCA GOLDBURG, PH.D.

Question. You state in your testimony that S. 1195 has many failings, but specifically three improvements are needed: (1) clear environmental standards, (2) better public participation, and (3) multiple-use planning and management. In your mind, if these improvements are made, can development of an offshore aquaculture indus-

try be guided in such a way that the result is an environmentally sustainable, economically viable, and socially fair outcome? Specifically, as lawmakers, how can we ensure such an outcome and dispel some of the current ambiguity in the bill?

Answer. The steps articulated in my testimony would go a long way to resolve environmental and socioeconomic issues associated with offshore aquaculture. However, some issues would remain.

Regulation would not resolve environmental issues for which no easy solutions are currently available. As discussed in my testimony, cultivation of most marine finfish requires that more wild fish be used as inputs in feed than is ultimately harvested from fish farms. This net loss of fish protein results in several problems and will likely increase global fishing pressure on wild fish populations as demand and prices rise for limited supplies of fish meal and fish oil. Alternative feed sources are currently in research and development, but truly sustainable marine aquaculture will not be possible until alternative feeds are readily available at reasonable cost to fish farmers.

The economic viability of offshore aquaculture in U.S. waters is another issue. As discussed in answers to questions above, it remains unclear whether U.S. offshore fish farming can compete economically with production abroad.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. OLYMPIA J. SNOWE TO SEBASTIAN BELLE

Question 1. Following up on your testimony, can you please elaborate upon why the additional two permits in the proposed bill would lead to unnecessary and redundant regulations? How much money could your operations save simply by having a single, streamlined permitting process?

Answer. My concern about two permits stems from our experience in Maine. In general, the more permits one has to apply for the longer the process becomes and the less assured the process outcome is. For example, in Maine we now have three principle permits we must apply for. Multiple agencies are involved and multiple public hearings and meetings take place. This process can easily take up to 3 years for a judgment to be rendered. It is entirely possible to go through the long process, spend large sums of money and in the end be turned down. Even worse, it is possible to go through the process get two out of three permits and be unable to start operations because of the lack of the third permit. Multiple permits increase the complexity and uncertainty involved in the permitting process. Please remember that no business activity can begin until ALL the permits are granted. Aquaculture is a risk laden business to begin with; it is new, occurs in an unpredictable hostile environment and involves keeping animals alive for long production cycles. Add to these risks permitting complexity, uncertainty and long processes and it is difficult to convince private capital to risk investing.

It is difficult to estimate accurately how much money would be saved by a single streamlined permit process without knowing what the proposed process would cost. Perhaps the best way is to look at the Maine model. At one time Maine had a one agency, one stop permitting process. That process has now devolved to a multi-agency, multi-permit process. When the process was a one stop process the average permitting costs ranged from less than $2,000 for a small scale shellfish application to around $10,000 for a modest finfish application. Today under the multi-agency, multi-permit model, the average application costs range from a minimum of $3,500 to well over $100,000. On larger finfish applications these costs can easily exceed $300,000.

What is important here is that these costs make it very difficult for family-owned smaller operations to startup. If environmental institutions are concerned about large "corporate" operations, then they should support a tiered application process that allows smaller operations to start with lower permitting requirements initially, good monitoring requirements that document whether operations are having unacceptable environmental impacts and provide for a step-up series of permits linked to the level of operations. The key would be establishing initial threshold levels for the step up permits that would allow activity levels high enough to generate adequate economic returns in the startup phase. If these thresholds were established too low then initial investment would not be likely to occur.

In an offshore environment, acceptable thresholds might be 1–2 million animals stocked per year. If a farm wanted to stock above these levels, an operation would have to go through a more comprehensive permitting process with full environmental impact assessment. Below these levels, a quick permitting system that would examine potential user conflicts could be employed. At the lower permitting level, in order to protect against unacceptable environmental impact, annual envi-

ronmental monitoring would be required. Above the thresholds, a full environmental assessment would be required before operations began. However, once operations began, assuming the original environmental assessment included impact modeling, field monitoring would occur only at the end of each production cycle to ground true environmental impact predictions.

Question 2. Exactly how do you think the regulatory framework proposed in Federal legislation should be streamlined? Are these issues that could be worked out in the rulemaking process? If not, why not?

Answer. Combine the two proposed permits into one with interagency consultation between NOAA and other concerned agencies and jurisdiction. We oppose categorically giving the regional fisheries councils permitting authority as is currently being proposed. There are two reasons for our opposition: (a) The track record of the councils in terms of effective management is poor. This has been confirmed by numerous external reviews. There is widespread interest in reforming these jurisdictional bodies. To embed aquaculture in these entities as well as require multiple permits from NOAA would preclude any aquaculture development. Instead of waiting for a long drawn out permitting process which then has to go through a decisionmaking body that has no aquaculture or environmental impact expertise, investors will invest overseas. (b) The regional fisheries councils are in many instances effectively controlled by commercial fishing interests. Some of the interests may produce products that aquaculture products will compete with in the market. Is it good public policy to give the regulatory oversight of one industry to a competing industry, particularly if both sectors operate under a license to use a public resource? How likely is it that a regional council, controlled by commercial fishing interests that may view (whether rightly or not) aquaculture as a threat, will grant an aquaculture permit in a timely fashion? Is this an effective way to help our country begin to realize the economic potential of a powerful economic development tool?

The closest answer we have to these questions can be seen in Alaska. Commercial fishermen pushed to have laws passed that precluded net pen culture in the state. They assumed that if they prohibited finfish aquaculture they would continue to be the major producers of salmon and would control the market. As an aside, having been a fisherman, I can tell you that fishermen never control markets, processors do. History has shown us that the Alaskan fishing communities assumptions were wrong. More salmon is farmed today than caught in Alaska. Fishermen find themselves out-competed, and out-priced as price takers. The reaction has been to aggressively try to distinguish wild salmon from farm salmon in the market place, in some cases by using irresponsible food scare tactics. Although the tactics may have at times been irresponsible, market segmentation and product differentiation is a good thing. Consumers like choice and price spreads allow consumers of varying means to choose what product is good for them. Two important facts remain however; the highest annual salmon catches that have ever occurred in Alaska would only supply 4–6 months of the U.S. market. Alaskan fishermen have lost the ability to use aquaculture as a tool to increase their competitiveness. In salmon, it is too late to catch up with countries like Chile and Norway. If Alaskan fishermen had chosen a combination of aquaculture and effective wild fishery management they would be the world leaders in salmon production today and our country would have a dramatically lower trade deficit. I would argue this is not a model we want to use if we are serious as a nation about using offshore aquaculture development as a powerful tool to diversify coastal communities economies, protect the security of our national food supply and reduce our trade deficit.

Government Financial Support

Question 3. In your testimony, you stated that direct government financial support is necessary to help get aquaculture operations off the ground. I think we should hear more about this proposal and what benefits the government might expect to be returned on this investment.

Could you please elaborate on what you think is the proper role of government support and investment in aquaculture? How should such a program work, from your point of view?

Answer. Our Nation has built many significant economic sectors through the careful investment of public funds; commercial fisheries and land-based agriculture are just two examples. Countries that my constituents compete with every day have invested tens of millions of dollars in commercial aquaculture development. These countries view aquaculture as a new and powerful tool with which they can diversify the economic base of coastal communities and vest those communities in environmental stewardship of marine resources and ecosystems. We need to do the same. Historically, Federal aquaculture involvement and expenditures have focused on three principle areas: policy and regulatory development, large-scale demonstra-

tion projects and a modest investment in applied research. While these efforts can be helpful, they do little to directly stimulate investment and innovation.

We need to refocus these efforts onto community and business development structures. Significant investment tools such as tax incentives, loan guarantees and outright development grants should be the focus of a Comprehensive National Aquaculture Development Program (CNADP). The program's express goal should be to achieve national goals established by a private sector advisory board. Goals should include measurable metrics such as the number of new farms started per year, pounds produced, gross sales, numbers of people employed, percentage of seafood produced domestically and levels of private capital invested. This program should include a core staff with *actual* private sector operational aquaculture experience, not just experience at research institutions. The program should also include staff with significant economic development, business management and agricultural financing experience. The focus of the program should *not* be natural resource management. We have numerous state and Federal jurisdictions and entities already charged with this responsibility.

The CNADP should be given authority for any Federal funds to be expended on aquaculture research including Sea Grant in order to eliminate duplication of efforts and focus research efforts on critical bottlenecks in the development cycle. The program should include a research advisory board made up largely of private sector aquaculturalists and university researchers who do not have conflicts of interest. This advisory board should include advisors from outside the United States from countries with growing and successful aquaculture sectors. Both the national program and research advisory boards should develop 5, 10, and 30-year plans with measurable benchmarks. The 30-year plan should be reassessed every 5 years to ensure it is technically relevant and achievable. At that review, a new 5 and 10 year program should be developed. The Director of Comprehensive National Aquaculture Development Plan should report directly to the Secretary of Commerce and Co-Chair of the Joint Subcommittee on Aquaculture with a USDA representative of similar stature. The CNADP should have resources adequate to discharge its responsibilities and after 15 years, the level of funding for the program should be dependent on significant progress in the measurable goals established in the plan. The CNADP should have resources similar to the combined budgets of the USDA land grant research budgets and all USDA development programs combined.

Question 4. How much funding is needed to help launch commercial operations? Following this investment, how much economic activity would the industry generate for our country? What other social benefits could be realized?

Answer. This depends entirely on the type of operation being started. Typical offshore projects in other countries have ranged from $1 million to over $40 million. If a project is successful internal returns on investment vary from 10–18 percent. There are widely varying estimates in terms of appropriate multiplier rates to use when talking about economic activity and impact of aquaculture operations. I personally am very suspicious of multipliers because they are often used by project proponents to justify investment. Having said that, I can report on our actual experience in Maine. These figures can give a sense of the potential level of contribution offshore aquaculture development might make. In a two recent independent studies that used actual reported production and audits of internal company books, the following ranges of economic impacts were reported. Please remember that these figures are being reported for a period during which our three largest salmon producers left the state due to the listing of local wild salmon stocks as endangered species. This means that the gross revenues and employment figures are significantly down. The economic impact ratios should however be representative. Another thing to remember is that our operations are a mix of fresh and saltwater finfish and shellfish operations. These operations are all located within state waters.

Historically, direct aquaculture sales in Maine have been as high as $130 million. During the two recent study periods direct annual sales for the aquaculture sector in Maine varied between $50 and $82 million. Of those revenues, between $32 and $50 million was spent on direct inputs. An additional $30 to $48.5 million was contributed through indirect spending. Between 800 and 1,400 Maine citizens were employed and earned between $32 and $56 million. Average compensation level was $40,000, significantly higher than the state average and almost double the averages in the two counties where many operations were located. Finally, these businesses paid between $5.6 and $9.7 million in state taxes. An examination of Federal tax contributions was not made.

Offshore operations will likely have some different economic characteristics, however, based on these actual figures, it would be reasonable to assume the following returns on offshore investment. For every $100 million in gross sales, $60.9 million in direct inputs, with an additional $59 million in induced and indirect economic ac-

tivity. Employment numbers and taxation figures are more difficult to project. I would however assume that average compensation rates would be higher that for inshore operations.

Fish Health and Environmental Impacts

Question 5. As you know, aquaculture could certainly affect surrounding waters, just as the quality of waters could affect the suitability of offshore aquaculture sites. This argues for a great deal of coordination in managing and monitoring offshore habitats.

What is the best way to achieve coordination in managing and monitoring the impacts of aquaculture on offshore habitats? How should NOAA work with states, other Federal bodies, and the industry on environmental quality and fish health on an ongoing basis?

Answer. To some extent, I answered this in the first question. In terms of environmental quality, appropriate site selection is the key. This can be difficult in instances when the species is being cultured for the first time. Without having actual farming experience with a species, it is sometimes difficult to know what site characteristics are important to maintain animal performance and minimize environmental impacts. This is another argument for the tiered permitting approach. Allow a modest operation to start up, monitor it well and encourage farmers through incentives and disincentives to farm within the carrying capacity of the specific site. Every site is different and will react differently to different production cycles and species. NOAA currently has little to no expertise in assessing these issues. EPA has expertise and a permitting process that would be required anyway. Why reinvent the wheel or impose an additional requirement of operators. NOAA should consult with EPA on all environmental impact matters.

In terms of aquatic animal health, this is a relatively new field and no Federal agency has extensive expertise in it. There are individual professionals within NOAA, USFWS and USDA that have some expertise. There is only one Federal staffer to my knowledge that has any experience with production aquatic animal veterinary care. In the face of this lack of expertise, there are significant misconceptions about the risks associated with commercial aquaculture facilities. This is a very serious situation that is significantly contributing to public misconceptions and inhibiting the development of both inshore and offshore aquaculture in the country. NOAA, USFWS and USDA have signed an interagency MOU to try to improve interagency coordination. From the private-sector's perspective this has achieved nothing other than the agencies saying they will continue to do what they have been doing and to talk to each other. It is my view that all aquatic animal health expertise and resources should be housed within USDA. This agency has extensive animal health experience and expertise. They understand production veterinary animal health management and have an established structure for regulating private farm operations. NOAA should consult with USDA on all aquatic animal health issues.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARIA CANTWELL TO SEBASTIAN BELLE

Question. Can you please share with me some of the most important lessons learned from the Maine aquaculture experience?

Answer. The most important lesson has been to allow incremental development with appropriate monitoring and adaptive management. This approach does not inhibit investors risking capital in an uncertain field but does ensure that inappropriate environmental impacts do not occur. The other lesson has been that without significant government investment in the early development stages, it is very difficult for domestic operations to compete with overseas competitors. Maine's aquaculture farms began operations in the 1970s. So did Norway's. Chile's started a little later. Norway and Chile are now world leaders. Although Maine leads the U.S. in marine production, we supply less that 2 percent of the U.S. market. Although there are a number of reasons for this disparity, perhaps one of the largest is that both Chile and Norway have invested hundreds of millions of dollars in economic development funds to grow the sector. Please see my answer to the question above on governmental financial support. Finally, the most encouraging lesson we have learned in Maine is that significant economic development can occur with very low environmental impact. Maine has a thirty year track record of rigorous environmental monitoring. This has allowed us to see when we are making mistakes, learn from them and correct our methods before those mistakes become critical. Maine farmers have developed some of the most innovative and environmentally-friendly farming methods in the world. These methods can be easily applied to offshore oper-

ations. We do not need to reinvent the wheel. As a country, we cannot afford to delay aquaculture development. Our economy and national food security depends on it. Our working waterfronts will wither without it. Our marine environments will loose citizens who are vested in their stewardship because they rely on healthy ecosystems in order to make their living.

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