U.S. Development of Offshore Aquaculture: Regulatory, Economic, and Political Factors

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Abstract

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Many freshwater and coastal aquaculture facilities are currently operating in the United States and contributing seafood products to domestic and global markets. These types of aquaculture have become successful industries, however that success has not yet expanded into United States federal waters. Regulatory, economic, and political factors that might explain the lack of development of an aquaculture industry in the United States Exclusive Economic Zone (EEZ) beyond state waters were examined through available literature, semi-structured interviews, and case examples of offshore aquaculture development projects. Analysis showed that while economic and political factors have a definite influence on the development of offshore aquaculture, the greatest barriers to the growth of the industry in the United States are the lack of a rational and comprehensive federal regulatory framework for offshore aquaculture, and lack of explicit regulatory authority naming NOAA as the lead federal agency. Until these regulatory factors are addressed, development of offshore aquaculture in the United States will continue to be on a project-by-project and permit-by-permit basis. This case-by-case approach, by

failing to address systematically important economic, political, jurisdictional, and ethical issues concerning the use of offshore waters for commercial aquaculture, is likely to continue to inhibit development of offshore aquaculture in the future. I conclude with a discussion of possible root causes for the lack of clear federal guidance with regard to offshore aquaculture, and I make recommendations for addressing the regulatory, economic and political factors that are inhibiting the development of offshore aquaculture in the United States.

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Dedication

This thesis is dedicated to Brian Edward Tucker, the love of my life.

Thank you for everything you've ever done. I love you.

1.0 Introduction

Many freshwater and coastal aquaculture facilities are currently operating in the United States and contributing seafood products to domestic and global markets. These types of aquaculture have become successful industries; however their success has not yet expanded to United States federal waters. While there is an increase in demand for seafood products at the national and global level, aquaculture production in the United States has remained confined to coastal waters. In order to understand the reasons for this lack of progression, this thesis examines and discusses the regulatory, economic, and political factors influencing the development of an aquaculture industry beyond state waters in the United States Exclusive Economic Zone (EEZ). These impact categories were selected after a series of informal interviews with knowledgeable parties and a review of literature that highlighted their apparent influences on development of federal regulations for offshore aquaculture, economic viability of the industry, and political consensus on the development of offshore aquaculture in the United States. Semi-structured interview questions were developed which encouraged interviewees to discuss their opinions on the influence of regulatory, economic and political factors, as well as their professional experiences with offshore aquaculture. Interviewees represented the National Oceanic and Atmospheric Administration (NOAA), the offshore aquaculture industry, research facilities that have shown interest in offshore aquaculture, and political interest groups that have become involved in the development of offshore aquaculture in the United States. An analysis of this information found patterns and gaps in opinions between and within interviewee categories with regard to actions to be taken to move forward with offshore aquaculture, and elucidated drivers behind regulatory, economic

and political influences on offshore aquaculture development. This analysis is also the basis for conclusions regarding the overall effects of these influences, and recommendations for steps to be taken to move toward a sustainable offshore aquaculture industry in United States federal waters.

1.1 Definition of "Offshore aquaculture"

The term "offshore aquaculture" is being used in this thesis to describe any aquaculture activities being undertaken in the United States Exclusive Economic Zone (EEZ). The EEZ extends from the outer boundary of state waters to 200 nautical miles (nm) from the coast. Most state waters extend 3 nm from the coast, however state waters of Texas, Puerto Rico, and the Gulf of Mexico coastline of Florida extend to 9 nm from the coast. The term "offshore" as used in this document refers to area between this 3 or 9 nm outer boundary of state waters and the 200 nm limit of the EEZ (NOAA, 2012).

The term "aquaculture" refers to the rearing of any marine species other than marine mammals and marine birds. It generally refers to the rearing of finfish, as that is the main focus of most offshore aquaculture operations, however it is not exclusive in its scope. Seaweeds, algae, and mollusks are among other types of marine species that may be included in the definition of aquaculture.

1.2 Problem definition

Aquaculture in the United States is a growing industry (Asche, 2010). Many inland freshwater and nearshore facilities are in operation currently, and are contributing

seafood products to the global market (NMFS, 2009). As depicted in Table 1, the United States aquaculture industry is dominated by the rearing of catfish, with the next most commonly produced species (by weight) being crawfish. Other finfish and shellfish are also produced in smaller quantities (NMFS, 2009). While these aquaculture activities have become working industries, their success has not extended beyond the boundaries of state waters. There are currently no large-scale commercial aquaculture facilities operating in United States federal waters. As is discussed further in this thesis, there is a growing demand for seafood at both the national and global scales that can no longer be met by wild-caught fishery resources.

Table 1. United States Aquaculture Production, 2007

Species	Thousand pounds	Thousand dollars
Finfish:		
Baitfish		38,018
Catfish	563,900	424,596
Salmon	24,253	40,814
Striped bass	11,239	31,455
Tilapia	20,000	34,383
Trout	52,210	62,757
Shellfish:		
Clams	10,743	65,754
Crawfish	114,623	88,906
Mussels	853	4,474
Oysters	20,944	81,536
Shrimp	5,022	10,046
Miscellaneous		320,970
TOTALS	823,787	1,203,709

Source: NMFS Office of Science and Technology, Fisheries Statistics Division, 2009

At the global scale aquaculture has seen a significant increase in production since the 1970s. Seafood production has grown from under 10 million metric tons in 1970 to around 60 million metric tons in 2006 (Asche, 2010). Seafood production in the United States has grown as well, with production rising 44% between 1991 and 1998 (Goldburg, 2001). However the United States, while being the third largest consumer of seafood is only 11th in aquaculture production (Goldburg 2001, DOC 2011). Approximately 84% of seafood consumed in the United States is imported from various locations around the world, and half of this amount is from foreign aquaculture operations (DOC, 2011). As shown in Figure 1, the majority of imported seafood comes from Asian countries, other North American countries, and South America, with the most commonly imported species (as shown in Table 2) being salmon, tuna, shrimp, crab, and lobster. Domestic production of seafood is dominated by channel catfish raised in the Mississippi delta region. Other domestic products include clams, Atlantic salmon, tilapia, striped bass, and shrimp (Goldburg, 2001). While domestically produced seafood is generally exported to Asian countries (NMFS, 2008), the United States has maintained a large trade deficit in seafood due to dependency on imports (Upton 2010, DOC 2011, NMFS 2008), in the amount of $9 billion since 2010 (Upton 2010, DOC 2011).

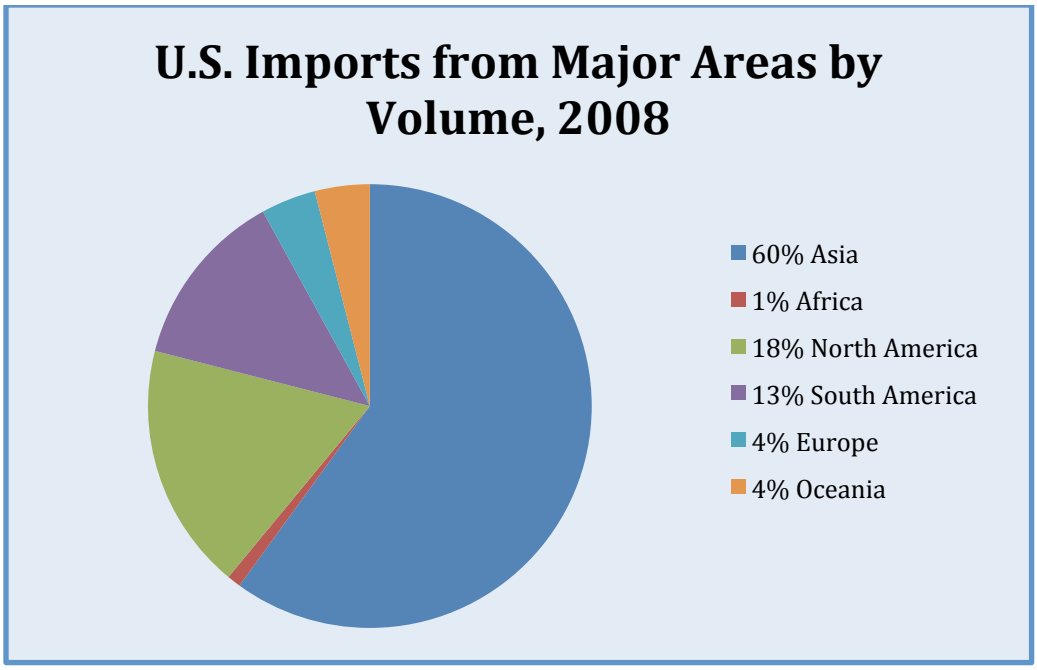

Figure 1. U.S. Imports from Major Areas by Volume in 2008
Source: NMFS Office of Science and Technology, Fisheries Statistics Division, 2009

Table 2. Seafood Imports to the United States over $500 million Value, 2008

		Thousand dollars
Fresh or frozen	Whole or eviscerated: Salmon	$515,571
	Whole or eviscerated: Tuna	$601,489
	Fillet and steaks: freshwater	$909,043
	Fillet and steaks: Salmon	$1,031,219
	Blocks and slabs: Crab	$721,136
	Blocks and slab: American lobster	$591,898
	Blocks and slabs: Shrimp	$4,084,391
Canned	Tuna	$661,360
	Crabmeat	$546,874

Source: NMFS Office of Science and Technology, Fisheries Statistics Division, 2009

Seafood species imported to the United States are either caught in the wild or raised using a variety of techniques that are adapted to the needs of the species, the environment, and the economic conditions surrounding production (Asche, 2010) Common production systems are ponds, pens, raceways, ropes, cages, tanks, and closed recirculating systems (Asche, 2010). Some systems are adapted for onshore production, such as recirculating

systems, while others, such as net pens, are mainly used in freshwater or marine environments. Growing demand for seafood and seafood protein has reached a point where wild-caught fisheries are not able to sustain the demand of the domestic or global market (MATF 2007, NOAA 2009). However, the United States does not have an explicit system in place to increase aquaculture production in its EEZ (Rieser 1999, Cicin-Sain 2001, Sununu 2006, GAO 2008). As noted earlier, most aquaculture facilities operating in marine environments in the United States are within State waters near to shore in coastal areas. Production of seafood has to date not been expanded at a commercial-scale beyond State waters into the United States Exclusive Economic Zone (EEZ), however the rising national and global demand for seafood has created an increase in interest for moving farther offshore (MATF, 2007). Within coastal areas use conflicts are high, and siting of aquaculture facilities can be difficult to do in a way that accommodates other coastal needs (MATF 2007, Ocean Conservancy 2011). Coastal zones and state waters of the United States are very actively used for industrial development such as mineral extraction and offshore energy production, recreation, conservation, and commercial fishing. While aquaculture facilities have managed to operate in some sites, it is becoming increasingly difficult to secure coastal areas for aquaculture that do not negatively interfere with other uses or values on both environmental and/or social grounds. For these reasons, there has been interest shown in moving offshore into the EEZ where use conflicts are relatively fewer and both environmental and social impacts of aquaculture development are potentially smaller.

Efforts to move aquaculture farther offshore into the United States EEZ have been made, however no operations have yet been able to establish themselves at a commercial scale. The National Oceanic and Atmospheric Administration (NOAA) has promoted the development of offshore aquaculture through the creation of a Gulf of Mexico Fishery Management Plan for Offshore Aquaculture and the issuance of a Special Coral Reef Fishery Ecosystem Permit to an offshore aquaculture industry participant. These actions are discussed in Section 2.1.2 of this document. NOAA has also issued policy statements on the development of offshore aquaculture both in its 10-year Plan for Marine Aquaculture (2007) and in its Marine Aquaculture Policy (2011). A handful of companies have begun research and development projects offshore, however none has been established as a long-term project. Administrative actions taken to further the development of offshore aquaculture in the United States have been met with litigation (Gulf Restoration Network, Inc. et al. v. NMFS 2009, KAHEA and Food & Water Watch v. NMFS 2012), and action at the congressional level has been at a stalemate in efforts to further the development of offshore aquaculture in the United States EEZ.

This study examines possible reasons for the lack of offshore aquaculture development in the United States EEZ. Despite actions taken by NOAA to establish the industry, experimental offshore aquaculture projects being undertaken, and legislation being introduced to Congress, offshore aquaculture has yet to emerge as a commercially competitive industry. In order to understand the reasons for this lack of development, this study considers regulatory, economic, and political factors with potential influences on the development of offshore aquaculture in the United States.

This study is centered on answering three principal research questions:

- How have regulatory factors influenced the development of offshore aquaculture in the United States?
- How have economic factors influenced the development of offshore aquaculture in the United States?
- How have political factors influenced the development of offshore aquaculture in the United States?

2.0 Background

My examination of academic literature, legal documents, permitting and regulatory documents, and administrative documents led me to conclude that the factors exerting greatest influence on the current state of offshore aquaculture development in the United States fall into three general categories: regulatory, economic and political. This section examines those influences in greater detail, based on that review.

2.1 Regulatory

Regulation of offshore aquaculture in the United States currently consists of a fragmented network of laws and regulations that apply generally but not explicitly to offshore aquaculture. This section discusses the mix of regulatory authorities, and attempts to designate a lead federal agency for offshore aquaculture regulation.

2.1.1 Regulatory authority for offshore aquaculture in the United States

It is broadly agreed among stakeholders that NOAA should be the lead federal agency to regulate offshore aquaculture activities under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (GAO, 2009). While it is the belief of many that NOAA is the obvious agency for this role, previous legislation has identified the Department of Agriculture (DOA) as the lead federal agency "with respect to the coordination and dissemination of national aquaculture information…" (quoted from the National Aquaculture Act (NAA), 1980).

On August 2, 1979 Senator Daniel Inouye (D-HI) introduced S. 1650: the National Aquaculture Act to the 96th Congress. Along with the sponsorship of Senator Inouye, this bill had 12 cosponsors. On September 11, 1980 it was referred to the Senate Committee on Agriculture, Nutrition and Forestry as well as the Senate Committee on Commerce, Science and Transportation. It was ultimately passed by both the House and the Senate, and signed by President Carter on September 26, 1980 (Govtrack.us, 2012).

This bill was enacted with the purpose of "promoting aquaculture in the United States," through a series of objectives aimed at creating a national policy for aquaculture, establishing a development plan, establishing a lead federal agency for information dissemination and agency coordination, and encouraging aquaculture activities (NAA, 1980). As stated by President Carter when signing the bill, it aimed to assist the United States government in "developing new sources of food for this country and for the poorer nations of the world." President Carter also noted the potential for the growth of a domestic aquaculture industry to narrow the trade imbalance that existed in 1980, and the potential for the NAA to benefit farmers of freshwater fish as well as commercial fishermen who will see a rise in the yield of wild stocks due to the increase in commercial aquaculture (Carter, 1980).

Enactment of the NAA in 1980 established the Joint Subcommittee on Aquaculture (JSA) as a coordinating group for interagency efforts to promote aquaculture and "increase the overall effectiveness and productivity of Federal aquaculture research, transfer, and assistance programs" (NAA 1980, JSA 2009). The NAA directed the JSA to develop a

National Aquaculture Development Plan (NADP) which would identify potential species to be developed for aquaculture, recommend actions taken to achieve this potential, promote research programs, and identify potential restraints to development of aquaculture (NAA, 1980). This plan was completed in 1983. However the NADP, while meeting the requirement of the NAA to develop a plan, provides no mandate to the DOA to develop policies or a regulatory framework for aquaculture (NADP, 1983). While the NADP has been adequate for development and management of freshwater and coastal aquaculture, the DOA does not have the expertise to develop and manage aquaculture activities offshore and has not created a regulatory framework for this aspect of the industry.

Due to the lack of a comprehensive federal regulatory framework, current federal regulatory authority of offshore aquaculture falls under the scope of numerous federal regulations and laws, each with an aspect that may apply to the industry, but was not designed specifically for this application (GAO, 2009). The current regulatory system is a piecemeal framework of numerous agencies attempting to apply their authority to offshore aquaculture development. Federal laws and regulations applicable to offshore aquaculture are shown in Table 3 below. Currently, in order to navigate the permitting process for offshore aquaculture, an applicant must satisfy the requirements of each of these listed federal regulations, some of which, as noted in Section 2.1.2, are not explicit in how they address offshore aquaculture. It must also be noted that while state laws and regulations are not discussed in this thesis, they may also require additional permits and compliance measures.

Table 3. Federal Agency Authorities Relevant to Offshore Aquaculture

Agency	Responsibility	Authority
Department of Agriculture	• Information dissemination and coordination • Promotion of aquaculture	• National Aquaculture Act
NMFS	• Consult with regulating agencies regarding impacts of permitting activities on living marine resources, marine mammals, essential fish habitat, and endangered species	• Marine Mammal Protection Act • Endangered Species Act • Magnuson-Stevens Act • Fish and Wildlife Coordination Act
	• Regulate fishing activities, including aquaculture.	• Magnuson-Stevens Act
	• Cooperate with other federal agencies to implement the NADP	• National Aquaculture Act
	• Enforce prohibitions on the sale, trade, or transportation of fish or wildlife harvested or attained in violation of federal, state, tribal or foreign laws	• Lacey Act
National Ocean Service	• Review and approve state coastal management programs, which identify permissible water uses in the coastal zone. • Oversee federal consistency with these programs	• Coastal Zone Management Act
	• Regulate activities in National Marine Sanctuaries	• National Marine Sanctuaries Act
Army Corps of Engineers	• Regulate structures in navigable waters through Section 10 permits	• Rivers and Harbors Act
		• Outer Continental Shelf Lands Act
Environmental Protection Agency	• Regulate discharges to navigable waters through NPDES permits	• Clean Water Act
Fish and Wildlife Service	• Consult with permitting agencies regarding impact of permitted activities on fish and wildlife, including endangered species	• Fish and Wildlife Coordination Act
		• Endangered Species Act
	• Regulate the importation and interstate transportation of fish under humane and healthful conditions	• Lacey Act
Bureau of Ocean Energy Management/Bureau of Safety and Environmental Enforcement (formerly BOEMRE and MMS)	• Authorize the use of existing facilities on the outer continental shelf for marine-related activities including aquaculture	• Outer Continental Shelf Lands Act

Continued: Federal Agency Authorities Relevant to Offshore Aquaculture		
Agency	**Responsibility**	**Authority**
Animal and Plant Health Inspection Service	• Regulate movement of aquatic animals in interstate and foreign commerce and respond to aquatic animal disease outbreaks	• Animal Health Protection Act
United States Coast Guard	• Require structures located in the jurisdiction of the United States to be marked with lights and signals to protect navigation	• Rivers and Harbors Act

Source: United States Government Accountability Office, Offshore Marine Aquaculture, 2009

2.1.2 Assertions of authority by NMFS

NOAA has maintained that aquaculture activities are considered "fishing" as defined by the Magnuson-Stevens Act, which gives NMFS the authority to regulate aquaculture activities (Johnson 1993, NOAA 2009, NOAA 2011). This view is based on the definition of "fishing" in the Magnuson-Stevens Act, which includes, "(A) the catching, taking, or harvesting of fish; (B) the attempted catching, taking or harvesting of fish; (C) any other activity which can reasonably be expected to result in the catching, taking, or harvesting of fish; (D) or any operations at sea in support of or in preparation for any activity described in subparagraphs (A) through (C)…" (Magnuson-Stevens Act, 1996)

An early assertion by NMFS of its regulatory authority is contained in a 1993 legal opinion written by Jay Johnson, the Deputy General Counsel for NOAA at the time (Johnson, 1993). This memo addresses a proposal by American Norwegian Fish Farm, Inc. (ANFFI) to operate an Atlantic salmon farm within the United States EEZ. In this opinion it is explicitly stated that aquaculture activities in the EEZ fall into the category of "harvested" fish under the Magnuson-Stevens Act, and therefore are subject to NMFS

authority. The opinion also asserts that the vessels that would be supporting these activities are considered "fishing vessels" by the United States Coast Guard (Coast Guard) and therefore also fall under the Magnuson-Stevens Act (Johnson, 1993). The General Counsel is a source of legal advice for NOAA but does not have authority to promulgate regulations. This memo states NOAA's own interpretation of its role in the regulation of offshore aquaculture (NOAA, 2012). While this interpretation is not binding, courts may take it into consideration in the process of litigation. It is not uncommon for a court to defer to an agency's interpretation of its authority, and if accepted by the court, this memo may set a legal precedent for future cases in the same vein. Thus far, this memo has not been the basis for any legal decisions.

Between 1993 and the early 2000s interest in development of offshore aquaculture was minimal. Interest began to grow again around 2004 and 2005 as research projects were being planned and implemented in Hawaii, Florida, Puerto Rico, New Hampshire, California and the Gulf of Mexico (FWW, 2007b). Initial research was being conducted, however there was no action aimed at development of a federal framework for offshore aquaculture development until 2004 and 2005.

Beginning in 2005, various attempts have been made to promote NOAA as the lead federal agency for offshore aquaculture (Sununu, 2006). NMFS has taken steps forward and used its authority to regulate "fishing" to grant permits for offshore aquaculture activities (NOAA 2009, NOAA 2011). Some of these attempts, however, have been met with litigation, which has stalled the process and led to no setting of precedents regarding

lead federal agency authority (Gulf Restoration Network, Inc. et al. v. National Marine Fisheries Service et al. 2010, KAHEA and Food & Water Watch v. NMFS 2011). In 2005 NMFS drafted the National Offshore Aquaculture Act (NOA Act) in an attempt to establish the Secretary of Commerce as the lead federal authority for development of offshore aquaculture in the United States. This bill is discussed further in Section 2.1.3 as an attempt at creating explicit authority for NOAA to regulate offshore aquaculture and subsequently develop a federal regulatory framework. It died in committee in Congress in 2005 and was reintroduced in 2007; however it was not enacted. In 2007 NOAA released its 10-year Plan for Marine Aquaculture with the stated goals of creating a comprehensive regulatory framework for offshore aquaculture development, establishing research and development strategies and financial incentives, and providing clear, accurate and up-to-date scientific information to decision makers and the public (NOAA, 2007). Most recently, in January of 2009 the Gulf of Mexico Fishery Management Council (GOMFMC) submitted its Final Fishery Management Plan for Regulating Offshore Aquaculture in the Gulf of Mexico (Gulf FMP) to NMFS for review. This plan aimed to create a regional framework for regulation of offshore aquaculture in the Gulf of Mexico EEZ.

Although allowing the Gulf FMP to go into effect, NMFS cautioned that this type of plan was unprecedented, and should not be acted upon until further action was taken by NOAA to establish a regulatory framework for offshore aquaculture in the United States EEZ. (Gulf Restoration Network, Inc. et al. v. National Marine Fisheries Service et al., 2010). This decision by NMFS to allow the Gulf FMP to go into effect was immediately

challenged in court (Gulf Restoration Network, Inc. et al. v. National Marine Fisheries Service et al., 2010). The court ruled, however that because NMFS had not taken any action on the Gulf FMP, it could not have had any adverse affect on the plaintiff. It also stated that in order for any permitting by the GOMFMC to take place, regulations for implementation must be in place (Gulf Restoration Network, Inc. et. al. v. National Marine Fisheries Service et. al., 2010). Until these regulations are in place, no further action can be taken for development of offshore aquaculture in the Gulf of Mexico. NOAA has issued a policy statement on offshore aquaculture development stating its position on the development of offshore aquaculture (NOAA, 2011); however no explicit authority has been granted via legislation in response to this policy statement.

2.1.3 Congressional interest in offshore aquaculture development

Since passage of the NAA, a number of other pieces of legislation have been introduced that would have had major implications for offshore aquaculture development in the United States had they been enacted. The National Offshore Aquaculture Act was first introduced in 2005 as S. 1195 by Senator Ted Stevens of Alaska (NOA Act, 2005). This act proposed to provide the Secretary of Commerce (Secretary) with the authority for "establishment and implementation of a regulatory system for offshore aquaculture in the United States Exclusive Economic Zone…" (NOA Act, 2005). This bill was drafted by NMFS and aimed to a) produce food, b) protect wild stocks and quality of marine ecosystems, c) provide necessary authorities and procedures for offshore aquaculture operations, demonstrations, and d) research, and promote research and development to enable marine aquaculture operations to achieve their objectives while protecting the

environment (NOA Act, 2005). This bill was referred to the Senate Committee on Commerce, Science, and Transportation where it had two hearings, but was not passed out of Committee (Sourcewatch, 2008). It was reintroduced in 2007 with the same name by Rep. Nick Rahall as H.R. 2010 (Sourcewatch, 2008). These bills were strongly opposed by the national non-profit consumer organization Food & Water Watch (FWW) (FWW 2006, FWW 2007) which argued that the bill neither took a precautionary enough stance on development of offshore aquaculture, nor provided sufficient guidance for protection of the environment, human health, and fishing communities (FWW, 2006). FWW was highly vocal in its opposition and created a large quantity of material voicing its opinion (Sourcewatch, 2008). This bill was referred to the Committee on Natural Resources as well as the Ways and Means Committee and the Committee on Foreign Affairs (NOA Act, 2007). However it did not make it any further, and died in committee (Govtrack.us, 2012).

In December of 2009 Rep. Lois Capps of California introduced the National Sustainable Offshore Aquaculture Act as H.R. 4363. This bill proposed to "establish a regulatory system and research program for sustainable offshore aquaculture in the United States Exclusive Economic Zone…" (NSOAA, 2009). This bill aimed to authorize the Secretary of Commerce to determine sites for aquaculture, permit, regulate, monitor and enforce offshore aquaculture in the EEZ, and require the Secretary to issue regulations for permitting offshore aquaculture that prevent impacts to the marine environment or minimize them to the maximum extent possible (NSOAA, 2009). This bill also proposed a research program for guiding "precautionary development of offshore aquaculture in

the EEZ that ensures ecological sustainability and compatibility with healthy, functional ecosystems" (NSOAA, 2009). This act was strongly supported by the Ocean Conservancy, which had opposed the previous bill, now stating that the bill's precautionary approach to offshore aquaculture regulation created an "opportunity to protect the U.S. from the risks of poorly regulated open ocean aquaculture" (Ocean Conservancy, 2010). Other environmental conservation and protection-oriented groups as well as trade organizations supported this bill, citing its precautionary approach to permitting (NCMC, 2010), and its balance of environmental and economic aspects of offshore aquaculture development (SeafoodSource, 2010). While this bill enjoyed the support of most environmental conservation and protection groups and trade groups, strong opposition was again felt from Food & Water Watch, which stated that this bill would be "harmful, especially to consumers, coastal and fishing communities and the environment..." and that it would "streamline permitting for industrial fish farms in all federal waters, allowing them to become big business in the U.S." (Wright, 2010). The NSOAA died in committee in the 111th Congress and was reintroduced by Rep. Capps in 2011 to the 112th Congress as H.R. 2373 under the same name (NSOAA, 2011). This bill was referred to the House Committee on Natural Resources and has not yet been reported out by the Committee, and it is anticipated that this bill will not be enacted either (Govtrack.us, 2011).

In May of 2010, Sen. David Vitter introduced S. 3417: The Research in Aquaculture Opportunity and Responsibility Act to the 111th Congress. This bill aimed to prohibit offshore aquaculture development in the United States until three years after the

submission of a report on the impacts of offshore aquaculture (RAORA, 2010). This bill was referred to the Senate Committee on Commerce, Science, and Transportation, but was not reported by the Committee.

In February of 2011 Rep. Donald Young of Alaska introduced H.R. 574: To Prohibit the Secretary of the Interior and the Secretary of Commerce from authorizing commercial finfish aquaculture operations in the Exclusive Economic Zone except in accordance with a law authorizing such action. This bill was referred to the House Committee on Natural Resources, and has not yet been reported by the Committee (H.R. 574, 2011). This bill, if enacted, would prohibit the Secretary of the Interior and the Secretary of Commerce from issuing "any permit or in any other way authorizing any person to conduct commercial finfish aquaculture operations in the Exclusive Economic Zone of the United States… except in accordance with a law authorizing such action that is enacted after the enactment of this Act" (H.R. 574, 2011). This bill is not expected to be enacted by the 112th Congress (Govtracker.us, 2012). The State of Alaska, desirous of protecting its wild salmon fisheries, prohibits salmon aquaculture in state waters.

2.2 Economic

Economic factors influencing the development of offshore aquaculture in the United States exist at both the global and the national scale. Globally, many economically valuable fisheries are being overfished, and aquaculture activities have been contributing to the production of seafood for global trade (The World Bank, 2009). It is estimated that approximately 50% of food fish consumed globally is produced in aquaculture facilities

(The World Bank, 2009). At the national scale, economic drivers for the development of domestic offshore aquaculture play a role in encouraging the growth of the industry, while some economic barriers to development may make it nearly impossible to do so.

2.2.1 Global and national economic factors

Currently the world's most valuable fish stocks are all either fully exploited or overexploited (The World Bank, 2009). Both global and national capacity for wild-caught fisheries is excessive, leading to decreased income levels for fishermen (The World Bank, 2009). In essence, there are more people fishing wild-caught fisheries than can be sustained ecologically and economically under current management regimes. If the status quo is maintained, as wild-caught fisheries become less sustainable they will not be able to meet the growing global demand for seafood (Cicin-Sain 2005, Keeney 2006, DOC 2011). It its 2009 report titled "The Sunken Billions," The World Bank asserts that global fisheries are being fished in a way that does not realize their full economic potential, and instead creates a net economic drain on the resource. This report continues to note that while aquaculture products can contribute to the decreasing value of wild-caught seafood in global markets, it has led to stabilization of seafood supplies and prices as demand has increased (The World Bank, 2009). Aquaculture operations have been increasingly contributing to the global seafood trade and currently comprise approximately 50% of seafood consumed at the global level (The World Bank, 2009). The United States, as mentioned earlier in this thesis, is 11th in the world for aquaculture production, and therefore has an opportunity to become a larger presence in the global seafood market (Goldburg, 2001).

At both the global and national levels, however, questions have been raised regarding the potential for competition between wild-caught fisheries and aquaculture products in the seafood market (Upton and Buck, 2010). Upton and Buck(2010) note that increased aquaculture production could have social and economic impacts on both wild-caught fisheries and the communities that have strong ties to the industry. While aquaculture could potentially supplement wild-caught fisheries products and provide larger quantities of seafood at lower prices to the consumer, this could also lead to a loss of employment in the fisheries sector. Increased supply of seafood products could lower the market cost, leading to lowered income for wild-capture fishermen, and subsequent changes to fishing communities reliant on the industry for livelihoods (Upton, 2010). This type of impact has been shown to occur in both the Gulf of Mexico shrimp fishery and the Alaska salmon fishery, where aquaculture products were introduced to the market and prices fell. Upton (2010) points out, however, that neither of these industries was entirely replaced by aquaculture, and offers the opinion that the additional competition could provide incentives for improvement of the quality of wild products, management institutions for wild-caught fisheries, and marketing techniques. The degree of competition with wild-caught fisheries also depends on whether new markets are created by the addition of aquaculture products to the global market, and the speed and size of production outputs from aquaculture facilities (DOC, 2010). Competition largely hinges on whether seafood products introduced to a market will supplant the existing products, or whether they will create a new market, leaving the existing wild-caught products relatively unaffected by introduction of a new product.

As discussed in Section 1.2, the United States currently imports the majority (by value not volume) of its seafood, which has led to a large trade deficit in this economic sector (Upton, 2010). Proponents of the industry have often stated that development of an offshore aquaculture industry in the United States will help to lower this deficit (Upton, 2010). The Department of Commerce (DOC) has a vested interest in lowering this deficit, and has cited offshore aquaculture development as a potential way to accomplish this goal (DOC, 2011). It is the belief of the DOC that aquaculture--land-based, nearshore and offshore--can help close the trade deficit in seafood, as well as provide jobs (DOC, 2011). This stance of the DOC is reflected in the drafting of its Aquaculture Policy (DOC, 2011), as well as in the completion of the Marine Aquaculture Policy by NOAA (NOAA, 2011).

While the DOC has adopted this viewpoint on the development of offshore aquaculture, economic theory suggests that developing an industry simply to close a trade deficit is not adequate reasoning (Upton, 2010). This theory assumes that if a country has a comparative advantage in aquaculture production it should specialize in that, whereas the United States may not have comparable advantage as others, and in a free trade system would not benefit from increased emphasis on aquaculture production. Upton (2010) also notes that often trade is not as free as it is assumed to be in economic theory, and advantage is difficult to ascertain when new technologies can emerge and future economic trends are not easily discernible. If disadvantages and constraints to offshore aquaculture development in the United States can be overcome and other factors make development of a domestic industry economically viable economically beneficial to the

nation and the global economy, development of offshore aquaculture in the United States should be emphasized, Upton argues (Upton, 2010). The DOC, in a 2010 report, lists several competitive advantages of the United States in the development of offshore aquaculture, along with several disadvantages and hurdles that will need to be cleared in order for it to become a sustainable industry. These advantages and constraints are listed in Table 4. Many of the points listed in this table are discussed in this thesis.

Table 4. Comparative Advantages, Disadvantages and Constraints of U.S. Offshore Aquaculture

Comparative advantages	Large area for development of offshore aquaculture (the U.S. EEZ)
	Well-developed coastal infrastructure
	Strong home market
	Fresh and frozen food distribution systems
	High-value niche markets
	Educated workforce and people with animal husbandry skills
	U.S. produced feed ingredients
	Strong property laws
	Leading offshore aquaculture equipment designers and manufacturers
	Strong research and extension capabilities
Disadvantages and constraints	Complex regulations and lack of clear regulations for federal waters
	Use conflicts • High coastal land values for tourism and housing competing with shore side infrastructure development • Concerns from fishermen about competition • Concerns about environmental effects
	Competition with low-cost imported seafood
	High labor costs for processing seafood products
	Rising costs of energy and feed
	Technological and transport challenges

Source: Department of Commerce, Offshore Aquaculture in the United States: Issues and Economics, 2010

Nationally, the United States is also faced with a potential issue of food security as countries such as China that have exported products to the United States are beginning to become net importers of seafood (Personal communication, 2012). As is discussed further in Section 4.0 of this thesis, due to the shift of countries that have historically supplied the United States with seafood from net exporters to net importers, the United States will need to begin to produce more of its own seafood products if it intends to meet its anticipated future national demand for seafood. While the United States is in a lead role for rebuilding depleted fishery stocks and for managing sustainable stocks, it has done so by curtailing wild-caught fishing efforts (Personal communication, 2012). This has led to redevelopment of shoreline areas in a way that no longer focuses on working waterfronts and the associated infrastructure for processing, distributing, maintenance, and support of marine seafood industries. As is discussed in Section 5.0 of this thesis, the addition of large-scale marine aquaculture facilities would provide economic support to these industries, further supporting communities dependent on marine industries (Personal communication, 2012).

2.3 Political

Political factors impacting the development of offshore aquaculture in the United States are very diverse. The politics of offshore aquaculture are defined by government personnel at the national, regional, and state levels, as well as industry participants who are very involved in the politics of offshore aquaculture development, and a host of Non-Governmental Organizations (NGO), trade associations, and other interested parties. On

the government side, both legislative branches of government and executive agencies have been active participants.

2.3.1 Government stakeholders

Stakeholders in government face a variety of challenges pertaining to offshore aquaculture development. Under the direction of the Magnuson-Stevens Act, NOAA is tasked with taking "action to conserve and manage the fishery resources found off the coasts of the United States," as well as promoting "domestic commercial and recreational fishing under sound conservation and management principles…" While these two directives can be interpreted as potentially at odds with each other, NOAA has seemingly aimed to balance the two in the stance it has taken on the development of offshore aquaculture. As mentioned in Section 2.1.2, NOAA released its 10-year Plan for Marine Aquaculture in 2007, which stated its goals for promotion of the industry, and in June of 2011 NOAA released its final Aquaculture Policy (NOAA, 2011). The position taken on the development of offshore aquaculture can be characterized as cautionary but promotional (NOAA, 2011). This policy states that in order to reach its objective of "enabling sustainable marine aquaculture in the context of its multiple stewardship missions and broader social and economic goals…" NOAA must "integrate environmental, social and economic considerations in management decisions concerning aquaculture" (NOAA, 2011). Acting under this overarching policy of promoting aquaculture, the regional Fishery Management Councils (FMC) have taken on the role of encouraging offshore aquaculture development. Although no federal framework for offshore aquaculture has been developed as yet, it is the mission of NOAA and the FMCs

to promote it in a way that is consistent with its stewardship, social, and economic goals. As noted in Section 2.1.2, the Gulf of Mexico Fishery Management Council has made the greatest reach in development of a regulatory framework for offshore aquaculture with the Gulf of Mexico FMP for offshore aquaculture. While this FMP has been adopted by the GOMFMP, court rulings have determined that activities to permit offshore aquaculture in the Gulf of Mexico cannot proceed until a federal regulatory framework has been established (Gulf Restoration Network, Inc. et al. v. National Marine Fisheries Service et al., 2010).

2.3.2 Industry stakeholders

Several companies have spearheaded the development of offshore aquaculture in the United States It is the position of these industry stakeholders that it is essential to promote and encourage the development of offshore aquaculture in the United States as a way to bolster the United States economy as well as guarantee seafood farmed to the stringent standards of the United States. It is believed that the development of this industry will have positive social, economic and environmental benefits to the United States as well as other countries (GMIT 2002, HSWRI 2006, Kampachi Farms 2011, Open Blue 2012). Companies interested in developing offshore aquaculture have begun working through the permitting in various regions and states to try to navigate the process and determine what is necessary in order to promote this industry (GMIT 2002, HSWRI 2006, Hawaii DLNR 2009, Kampachi Farms 2011, HIOT 2012). A number of small research and experimental projects have been undertaken in the United States by various

industry participants who have navigated the current regulatory system of permits and requirements as described in Section 2.1.1 (NMFS, 2011).

2.3.3 Environmental non-governmental organizations

The environmental NGO community that has been involved in the development of offshore aquaculture in the United States has generally expressed varying levels of opposition. These groups have taken the stance that offshore aquaculture in the United States should either develop with very strong precautions (Ocean Conservancy, 2011), or not at all (Food & Water Watch, 2011). Environmental concerns include the potential for disease to spread between wild and farmed fish, nutrient loading and benthic impacts from waste and excess feeds, and increased pressure on wild fish species used for feed (Ocean Conservancy 2011, Food & Water Watch 2011). Social impacts commonly raised as areas of concern are the impacts to commercial fishermen that may stem from the increased delivery of product to the seafood market, possibly depressing prices, the potential for disease to spread between wild and raised fish, potential spatial conflicts, as well as an overall concern about the use of the ocean, a publicly owned resource, for private economic gain (Food & Water Watch, 2011).

As noted earlier, legal actions have been taken against NMFS regarding its actions on regulation of offshore aquaculture (Gulf Restoration Network et al. v. NMFS 2010, KAHEA and Food & Water Watch v. NMFS). While suits have not completely stopped the development of offshore aquaculture in the United States, they have slowed the process of precedent setting and framework building. The broad range of applicable laws

and regulations allows considerable room for interpretation and for overlapping in jurisdiction and impact. This, in turn, leads to more room for litigation. It is within this litigation-dominated political atmosphere that government stakeholders, industry stakeholders, and some NGOs are attempting to develop an environmentally, economically, and socially sustainable offshore aquaculture industry.

Review of position statements of NOAA, industry participants, and political interest groups along with findings of interviews as reported in this thesis reveal that the majority of stakeholders agree on a basic level that offshore aquaculture should be developed in the United States if it is done in a sustainable way (OSI 2008, NCMC 2010, DOC 2011, Kampachi Farms 2011, NOAA 2011, Ocean Conservancy 2011). As noted earlier in this section, NOAA has released its Marine Aquaculture Policy (2011) which states the position of NOAA as promotional, but cautionary. The Department of Commerce has also released its Draft Aquaculture Policy (2011), which echoes the policy of NOAA. Kampachi Farms and The Ocean Stewards have stated the position that offshore aquaculture can be developed in an environmentally sound way that is beneficial to the nation and the environment (OSI 2008, Kampachi Farms 2011). The National Coalition for Marine Conservation has stated that it supports the development of sustainable offshore aquaculture that values the health of marine ecosystems (NCMC, 2010), and the Ocean Conservancy also supports a precautionary approach to development of sustainable offshore aquaculture (Ocean Conservancy, 2011). While beliefs concerning the amount of regulatory precaution necessary differ across stakeholder groups, the general consensus is that offshore aquaculture should be developed in the United States.

Food & Water Watch has stated the opinion that offshore aquaculture should not develop at all in the United States regardless of the amount of precaution taken (FWW, 2011). Food & Water Watch while appearing to represent a minority opinion among stakeholders, nevertheless enjoys a great deal of support from its members, and has had very strong political influence on the development of offshore aquaculture. FWW was the plaintiff in a suit against NMFS regarding the acceptance of the Gulf FMP for offshore aquaculture, as well as in a suit against NMFS regarding issuance of a permit for Kampachi Farms' Velella Project. FWW has an aggressive information dissemination program that focuses on social and environmental concerns associated with development of offshore aquaculture. This information is available to the member community of FWW as well as the public.

2.4 Adversarial legalism

The high level of legal action involved in the development of a regulatory framework for offshore aquaculture can be attributed partially to the legal style of the United States, described by Robert Kagan as "adversarial legalism" (Kagan, 1991). Kagan defines adversarial legalism as, "a method of policymaking and dispute-resolution characterized by comparatively high degrees of formal legal contestation, litigant activism, and substantive legal uncertainty." This approach to policy-making and dispute resolution exists in the United States, according to Kagan (1991), due to:

- Complex legal rules
- Formal and adversarial procedures for resolving disputes
- Slower and costlier forms of legal contestation
- Stronger and more punitive legal sanctions

- Frequent judicial review of, and intervention into administrative decisions
- Political controversy about (and more frequent change of) legal rules and institutions

As has been shown in the discussion of offshore aquaculture thus far, and is further shown in upcoming discussions, competing interests have repeatedly called to attention their legal rights, duties and procedural requirements all of which fall into Kagan's category of formal legal contestation (Gulf Restoration Network et al. v. NMFS 2010, KAHEA and Food & Water Watch v. NMFS 2012). Kagan's last category for the definition of adversarial legalism is substantive legal uncertainty. This has also strongly impacted the development of offshore aquaculture in that official decisions made have often been non-binding, reversible or varied in predicted outcome. NOAA's declaration that it has the authority to regulate offshore aquaculture, coupled with its caution to regional FMCs not to try to act on that authority, is a case in point.

While adversarial legalism creates a method for concerned parties to have their voices heard and their opinions included in the policy making process, it also acts as a tool for creating "legal deadlock and socially harmful inertia" (Kagan, 1991). As Kagan notes, this tactic also prolongs the status quo, which is not always a positive outcome. Rather than implementing regulations for offshore aquaculture that can be malleable and adaptive by design to take necessary precautions and learn from experience, the status quo with importation by the United States of large quantities of seafood from fisheries less likely to meet standards of sustainability is maintained. Kagan states that having to "rely on bulletproof scientific evidence and procedural methods bogs down any

bureaucratic process for years." As discussed further in Sections 5.3 and 6.0, the status quo may not be the most beneficial management system for consumption of seafood in the United States.

3.0 Survey Methodology

In order to determine influences on the development of offshore aquaculture in the United States, this study began with a literature review to determine what types of factors were influencing the development of offshore aquaculture in the United States. Documents analyzed included peer reviewed literature, federal regulations relating to offshore aquaculture development, bills and acts introduced to Congress that have influenced the development of offshore aquaculture, or that would have influenced offshore aquaculture if they had been enacted, and bills not yet been passed still in committee. Government documents including Fishery Management Plans and federal agency policies on aquaculture were reviewed, as well as permit applications, acceptances, and denials for offshore aquaculture projects in the United States. Reports and articles analyzing the viability and sustainability of offshore aquaculture in the United States were analyzed, as well as private interest group reports on offshore aquaculture development in the United States.

Analysis of these documents, as well as consultation with personnel knowledgeable in the field led to the conclusion that the factors having the largest influence on the development of offshore aquaculture in the United States EEZ can be characterized as regulatory, economic, and political. An interview scheme employing semi-structured interviews was then developed that would address and better inform the details of these points. Questions were designed to obtain information in the categories of regulatory, economic, and political impacts to offshore aquaculture development. Emphasis was put

on developing questions that would encourage interviewees to share information about their personal experiences with offshore aquaculture development, and their own personal opinions on how each category; regulatory, economic, and political has influenced the development of the industry. Each category included three sets of nearly identical questions phrased slightly differently to accommodate the interviewee's familiarity with the subject. Some interviewees were very knowledgeable in answering questions regarding, for example, the regulatory factors influencing offshore aquaculture development in the United States but were not at all knowledgeable about the political factors. Because questions were developed at the same time as consultation with knowledgeable personnel they were not tested before the formal interview process was begun.

Interview subjects were chosen by their affiliation and position within their profession. Professional categories included agencies, industry, research and political interest. Agency personnel selected were in aquaculture offices, or held lead roles in aquaculture departments within their agency. Industry personnel chosen were the founders and CEOs of companies that have engaged in activities to develop offshore aquaculture. Research personnel include those who have been engaged in research on aspects of offshore aquaculture development either through universities or through the National Sea Grant Program. Political interest personnel were chosen because their organization has taken a public stance on the development of offshore aquaculture in the United States EEZ and has taken action to support or oppose it. Within each interviewee category, subjects were initially identified, and many made recommendations for other personnel who would

have input on the subject as well. For each interviewee, background information regarding their projects, affiliations and interests was collected through online searches and a pre-interview conversation. Interviews were conducted on the telephone, with some interviewees including additional interview responses in emails. Initial contact was made with approximately 20 interview subjects. Of the 20 subjects, 12 were willing to be interviewed.

Table 5. Interview Subjects by Professional Category

Professional category	Number of interview subjects
Agency	5
Industry	3
Research	2
Political interest	2
Total	**12**

Each interview began with an introduction explaining the project, the definition of offshore aquaculture as used in this study, and information about the estimated duration of the interview. Interviewees were told that throughout the interview any information could be taken "off the record" and at the end they would have a chance to state their preferences for confidentiality. Questions were then asked, and interviews ended with a final summary question, a set of "who are you" questions, and questions to specify the interviewee's confidentiality preferences. Interview questions can be found in Appendix A of this thesis.

Responses to interview questions were analyzed according to category, and patterns were extracted through examination of interview notes. These patterns were then analyzed for similarities or differences of opinion and put into table form for further discussion and analysis of experiences shared by interviewees and opinions stated. Based on the findings of the interview analysis, conclusions were drawn and recommendations given for types of actions necessary to move forward with the development of offshore aquaculture in the United States.

4.0 Interview analysis

Interview questions were formulated to provide an understanding of the opinions and views of personnel across the four interviewee categories; agency, industry, research, and political interest with regard to the influence of regulatory, economic, and political factors on the development of offshore aquaculture in the United States. In each subject area a qualifying question was asked first to determine the interviewee's familiarity with the subject. The appropriate set of interview questions in each category was then determined based on the answer to the initial qualifying question. As previously noted, interview questions are included in Appendix A of this document.

4.1 Impacts of regulatory factors on offshore aquaculture development

4.1.1 Help or hindrance

When asked if they felt that the current regulatory framework for offshore aquaculture helped or hindered the development of the industry, there was agreement across all interviewees that it is a hindrance. Interviewee explanations for these hindrances tended to fall into two distinct categories as shown in Table 6. The most commonly noted factor contributing to the limitation of development was the lack of a clear regulatory framework for offshore aquaculture in the United States, the other being closely related, a lack of action taken by congress to create a federal regulatory framework. There was agreement across all four sectors of interviewees that this lack of a clear federal regulatory framework is one of the main reasons for the slow development of the

industry. As stated by one Regional Aquaculture Coordinator with NMFS, the current system is “fractured and cumbersome…” and what is needed is a “rational and transparent permitting process” for offshore aquaculture. As discussed in Section 2.1.3, bills have been proposed that have outlined standards and criteria for the development of a regulatory framework for offshore aquaculture in the United States, however the content and political motivation of these bills has been questioned by some stakeholders, and Congress has not taken action to pass any of the proposed bills.

The National Sustainable Offshore Aquaculture Act of 2009 (reintroduced in 2011) was commonly referred to by interviewees as an example of standard setting and a precautionary approach to development of offshore aquaculture. Opinions of interviewees regarding this bill varied across stakeholder groups however. An interviewee in the industry category believes that the bill has the wrong motivations and perspective on environmental impacts. This interviewee asserts that this bill takes too precautionary an approach to offshore aquaculture development, and would build precautions into the legislation in a way that would not be conducive to the adaptive management of a growing industry that will necessitate regulatory changes as it evolves. This concern is seconded by an interviewee in the research category who states that assertiveness in regulatory solutions to the lack of a clear framework for offshore aquaculture could create a federal system that is not conducive to adaptive management. It is stated by this interviewee, as well as by interviewees in both the industry and political categories that adaptive management is necessary in a federal framework developed for offshore aquaculture in order to promote innovation and raise standards as the industry becomes

more established. An interviewee in the industry noted that while the current permitting process is extremely difficult to navigate and serves as a barrier to entry, it also serves to show that operations that are granted permits have met the high standards that have been set and offshore aquaculture can be done in a way that will be in compliance with applicable regulations.

Interviewees in both the industry and research categories have expressed opinions that research has shown that the ocean is adaptable, and if monitored properly, offshore aquaculture can have little to no lasting environmental impact. While this view is shared by others in the industry, research, and some political organizations, it contrasts with the views of some NGOs involved in the development of offshore aquaculture. One environmental NGO involved in the development of the NSOAA of 2009 viewed it as a chance to create a balance between the views of industry participants and the views of those who were concerned about the potential environmental impacts of offshore aquaculture development (Ocean Conservancy, 2011). This effort however, seems to have resulted in a bill that has not gained support from many stakeholders and has not moved beyond initial assignment to committee in Congress.

Many interviewees expressed preferences for ways regulatory hindrances should be addressed. Aside from one interviewee who believed that offshore aquaculture should not be developed, the majority of interviewees stated the need for an entirely new piece of legislation for offshore aquaculture development and agreed that NOAA should be named the lead federal agency for management of offshore aquaculture. Many

interviewees also noted the need for a streamlined, transparent and rational permitting process in order to address regulatory and economic issues previously discussed in this thesis. One interviewee in the offshore aquaculture industry offered an alternative suggestion that new legislation for offshore aquaculture development is not necessary, and would in fact delay the process further due to the nature of the legislative process. This suggestion acknowledged that the current system of permits and regulations is fragmented and can be extremely difficult to navigate, but argued that it can be streamlined to create a more comprehensive process for offshore aquaculture permitting without entirely new legislation. This opinion was based on the view that the legislative process tends to be a lengthy one, and it was this interviewee's opinion that offshore aquaculture production in the United States needs to begin at a large scale as soon as possible. One interviewee in the industry offered the suggestion that regional "blueprints" be created, which would outline standards and criteria for technology selection, species selection, site selection among others. The goal of this blueprint would be to streamline the permitting process, as the interviewee was of the opinion that applying for permits necessary for offshore aquaculture should be more like applying for a fishing permit than a multi-year process.

Another alternative proposed for offshore aquaculture regulation was a change in the planning regime. It was suggested by an interviewee in the offshore aquaculture industry that Marine Spatial Planning (MSP) should be ramped up, as it has been named a priority by the Interagency Ocean Policy Task Force (IOPTF, 2010). Under this approach, the site selection process for offshore aquaculture facilities would be done through the

designation of areas pre-approved for this use, and an applicant would then be able to avoid the site selection permitting process and apply only for other applicable permits. Another suggested alternative to MSP is the completion of large-scale EIS documents for areas designated for offshore aquaculture development. This idea was proposed by two interviewees, one in the offshore aquaculture industry and one in a federal agency position, who suggested that these EISs be completed by the government, presumably the regional FMCs of NMFS, who are familiar with the ecological needs and potential impacts of offshore aquaculture facilities. Such solutions would seemingly reduce the burden of site selection on the permittee by designating areas that are approvable for offshore aquaculture, allowing interested parties to apply for permits without having to prepare an Environmental Assessment and potentially an Environmental Impact Statement as well for each proposed project.

Table 6. Hindrances to Development of Offshore Aquaculture

Influencing factor	Detail	Ideas for change

Lack of clear regulatory framework for offshore aquaculture development in the U.S. EEZ between 3-200 nm	• Issue lies in the ambiguity of regulatory system
	  o Creates regulatory uncertainty
	  o Investment too risky
	• All applicable laws and regulations were developed for other purposes
	• Multiple agencies with regulatory jurisdiction
	• Important to have high standards to meet.
	  o Meeting these standards will set a good precedent for the industry
	• Goal of government to promote offshore aquaculture
	• Barriers to entry too high
	  o Onus currently on the permittee
	  o Navigation of the permitting process is time consuming, expensive, and challenging
		• Need to develop a new national framework for offshore aquaculture
		• Alternative is to keep same framework and iron out overlaps in agency jurisdiction
		• Need to develop a rational and transparent permitting process with certainty
		• Create a streamlined permitting process
		  o Officially recognize NOAA as the lead federal agency
		• Need for Marine Spatial Planning and inclusion of offshore aquaculture as a priority
		• Develop regional blueprints for offshore aquaculture to meet regional and federal standards with aquaculture practices
		  o Obtaining an aquaculture permit should be more like getting a fishing permit.
		  o Not a 2+ year process

Lack of action by Congress on offshore aquaculture development	• Highly influenced by opposition
	  o Opposition has more funding than proponents
	  o Influenced by misinformation in media
	• Environmental, social impacts unknown
	  o Assertiveness in proposed solutions dangerous and prohibitive to adaptation and innovation
		• Bring certainty to the regulatory process
		• Need adaptive management
		• Need to experiment at large scale

4.1.2 Use Conflicts

The second question in the regulatory category concerns the perceived influence of use conflicts on the development of offshore aquaculture in the United States. Interviewees were asked about the extent of use conflicts and the influence they may have on development, and were prompted to think about use conflicts in both a social and environmental context. Results are shown in Figure 2 below. It is worth noting that four of twelve interviewees stated that use conflicts are only perceived and do not actually exist. Two interviewees noted that use conflicts do not exist currently because offshore aquaculture in the United States does not yet exist at a commercial scale, and that talk of use conflicts currently is entirely speculation and cannot be stated as fact until operations actually exist. A federal employee with NOAA's Office of Aquaculture stated that while there may be some use conflicts, the majority are only perceived and are not the reality. An interviewee in the industry asserts that opponents of offshore aquaculture exaggerate potential conflicts when in reality offshore aquaculture takes up very little space and may in fact have a synergistic relationship with certain kinds of Marine Protected Areas (MPA). This interviewee cited a hypothetical example of an MPA aimed at protecting marine mammals. An aquaculture facility sited within the MPA could serve as a fish aggregation device for wild fish and attract marine mammals, which would benefit from the availability of food. This idea is echoed by the founder of another offshore aquaculture company who stated that there may be a conservation benefit to siting offshore aquaculture facilities in certain types of marine parks. Many interviewees stated

that while there may be potential use conflicts, a comprehensive planning and siting process can negate the majority of the potential negative social and environmental impacts that are shown in Figure 2 below.

Potential use conflicts noted include under sea mining, which was mentioned by one interviewee as something that should be accounted for in siting, but could easily be managed for in the siting process. One interviewee noted that potential conflict with navy training activities should be accounted for in the planning process for siting offshore aquaculture facilities, while three interviewees noted the potential for recreational users of the ocean to come into conflict with offshore aquaculture facilities. The most common recreational uses cited by interviewees were recreational boating and fishing, both of which have potential for spatial conflict with aquaculture facilities. It was also noted by two interviewees that recreational fishing could potentially be affected in the event of a disease outbreak. Three interviewees noted the potential for environmental impacts of offshore aquaculture facilities to negatively affect marine conservation efforts. These interviewees noted the potential for excess feed to create nutrient overloads, and for waste to gather in benthic habitats below offshore aquaculture facilities. These interviewees also cited the potential for disease outbreaks to impact wild fisheries, as well as potential for escaped fish to change the genetic structure of wild stocks. It was noted by five interviewees that there is potential for offshore aquaculture facilities to come into conflict with navigation in the EEZ if facilities are sited in areas that are commonly used by vessels. It was also stated by the majority of these interviewees that the siting process for offshore aquaculture can greatly reduce the potential for this type of conflict by

avoiding shipping lanes and complying with regulations specifying the type of marking necessary for obstructions to navigation. Commercial fishing was cited by five interviewees as having a potential use conflict with offshore aquaculture due to potential siting issues, ecological issues, and economic issues. Interviewees offered the opinion that facilities could be sited in areas frequented by commercial fishermen, which would make these areas no longer available for fishing. Ecological issues cited by interviewees were similar to those raised as potential conflicts with recreational fishermen, potential disease outbreaks, and change in genetic structure of wild stocks due to escaped fish. It was also noted that offshore aquaculture cages can be fish aggregating devices, which could potentially lead to fewer fish in areas open to commercial fishing. Five interviewees mentioned the potential for offshore aquaculture and offshore energy to have siting conflicts. Here it was noted that offshore drilling and offshore aquaculture may both be occurring in the U.S. EEZ, and offshore aquaculture will likely have to take into account the potential for offshore drilling in an area where a facility could potentially be sited.

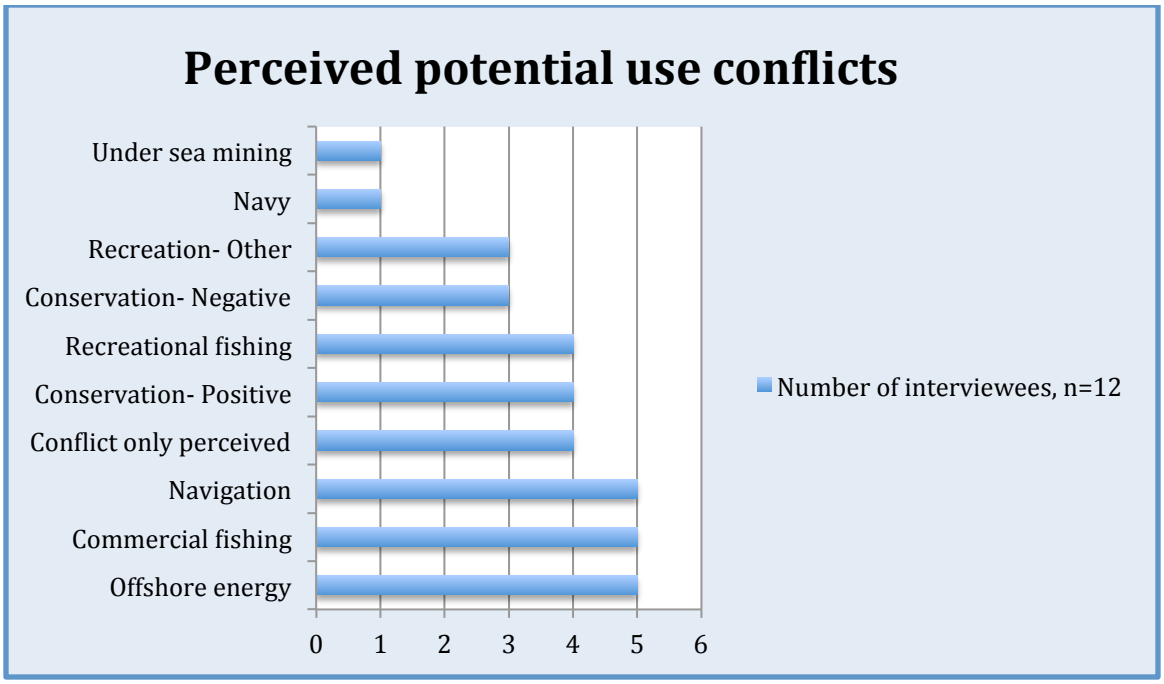

Figure 2. Perceived Potential Use Conflicts

4.1.3 Federal Consistency and the Coastal Zone Management Act

Interviewees were asked whether they thought that the Federal consistency clause of the Coastal Zone Management Act (CZMA) would be used by states in order to influence the development of offshore aquaculture.

The CZMA of 1972 aims to "preserve, protect, develop, and where possible, to restore or enhance the resources of the Nation's coastal zone… and to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through development and implementation of management programs…" (CZMA, 1972). Section 307 of the CZMA includes what is called the Federal Consistency provision. After NOAA accepts a state's Coastal Zone Management Plan, any Federal activity taken "in or outside of a state's coastal zone that has an effect on land, water use or natural resource of the coastal zone" must be consistent with state policies and management. This

includes any activity that obtains permits from a Federal agency. Permitting of an offshore aquaculture facility in the United States EEZ must be consistent "to the maximum extent practicable" with the policies of the state off whose coast the development is occurring.

A Federal agency taking action that may affect a state's land, water use or natural resources in their coastal zone must undergo a consistency review. This review is intended to show that the proposed action will be consistent with the applicable state policies. If it is determined that the Federal agency action is not in compliance with state policies, and mediation as defined in the CZMA will not result in compliance, the action can be appealed to the Secretary of Commerce (Secretary). In this case, the Secretary may request that the President determine if it is "in the paramount interest of the United States." If so, the Federal activity may be carried out as planned. If it is not determined that the action is of national interest to the United States the project must comply with state policies.

Each coastal state that is a participant in the CZMA must develop its own Coastal Zone Management Plan (CZMP). This allows states to develop plans that reflect their interests with regard to coastal development. These plans essentially give states a way to promote the values of their residents with regard to their coastal resources. Some interviewees acknowledged that the "attitudes" of states concerning offshore aquaculture development may differ based on the values of their residents. This factor may have a significant influence on the ability of federally permitted offshore aquaculture facilities to be in

compliance with state policies. If a state has very stringent environmental policies it may be more difficult for an offshore aquaculture facility to comply with state policies than development off the coast of a state whose CZMP reflects development and industry as highly valuable.

Interviewees were asked whether they thought the Federal Consistency provision would be used by states to deter offshore aquaculture development off their coasts. General responses to this question varied across individuals as shown in Table 7 below. While some thought that states would use the Federal Consistency provision in a way that may inhibit the development of offshore aquaculture, others stated that the Federal Consistency provision would be applied, but would not necessarily be a barrier to offshore aquaculture development. The majority of responses fell into these two categories, while one agency interviewee expressed the opinion that the Federal Consistency provision was an abdication of federal authority. This interviewee felt that states should not have authority over management of federal waters. Many interviewees noted that even if an offshore aquaculture facility is located in federal waters, it will necessitate activity in state waters such as transportation of supplies and infrastructure used for support, which will need to be consistent with state Coastal Zone Management Plans.

As noted in Table 7, the Federal Consistency provision has the potential to affect the permitting process, site selection, and environmental precautions to be taken. Interviewees generally agreed that this provision would be applicable and could have an

effect on the development of an offshore aquaculture project. One interviewee in the industry category noted that it is the state's prerogative to apply federal consistency, however aside from adding an extra layer of assurance for states, and an extra level of "headache" for industry participants it was generally agreed that the Federal Consistency provision would not necessarily have much impact on development of the industry. This sentiment was echoed by other interviewees in the industry, agency, research, and political interest categories who noted that while federal consistency could be applied by states, offshore aquaculture activities would be consistent with the CZM Plans of coastal states and would not be out of compliance. One interviewee in the research category stated that federal consistency may initially be a large hurdle for development of offshore aquaculture, however once it has been granted a few times and has been shown that generally offshore aquaculture activities do not impact the coastal zones of states, it will become less rigorous and other states will more willingly follow suit. It was also noted by an interviewee in the industry that the amount of influence the federal consistency provision will have will ultimately depend on the overall attitude of the state regarding aquaculture development and how influenced the state is by opposition to aquaculture. This interviewee noted that some states have already expressed concerns with siting of offshore aquaculture facilities. It is likely that consistency review in this state will be very rigorous when determining whether an offshore aquaculture facility will impact their coastal zone.

One interviewee in the political interest category stated that the Federal Consistency provision was helpful, but also noted that in a conflict between a state and a use

inconsistent with their CZMP, the ultimate arbiter is the Secretary of Commerce, who is aligned with NOAA. As is noted earlier in this section, the ultimate decision in a conflict over federal consistency lies with the President in determining whether an activity is of National importance or whether it is not. Some interviewees expressed discouragement with the amount of authority states are given through the Federal Consistency provision and gave the opinion that this provision is an abdication of the federal government's authority to regulate activities in federal waters of the United States. Others suggested that a federal regulatory framework for offshore aquaculture should include an "opt-out" option for states who were not interested in development of offshore aquaculture in Federal waters off their coastal zone. Opinions on the terms of this option varied. Three interviewees in the agency and industry categories noted that if a state does not want offshore aquaculture in the EEZ off its coast it should be able to opt out. This could save a lot of headache to those potentially interested in developing in those areas who would have to go through an onerous permitting process and ultimately may not be able to follow through with their proposed project. Interviewees differed on the tenure of the opt-out decision with some saying that it should be a final decision, while others believe it should be a twenty-year decision.

Table 7. States' Use of Federal Consistency in the CZMA

Interviewee opinion	Reasoning
States will apply federal consistency	• It is their prerogative • Even if an aquaculture facility is offshore, some activities will still need to take place in state waters. • Will want aquaculture permit from the state • Depends on what state regulations exist already and the attitude of the state as encouraging or discouraging offshore aquaculture • Certain states have already expressed siting concerns
Federal consistency does not need to be a problem	• Permitting process will become customary for agencies • May be a major hurdle in the short-term but if federal regulations are reasonable states will have reasonable regulations as well • Can get federal consistency review from the state • Once a regulatory framework is established, permitting will work with CZMA to assure consistency
States should not have power to use Federal consistency	• May provide another layer of assurance, but not necessary • Opens the door for states to veto • States shouldn't have authority over federal waters • Government is abdicating its power
States may apply federal consistency but it is not strong	• NOAA is the ultimate arbiter if federal consistency ruling is appealed. o NOAA in favor of offshore aquaculture
States should have an "opt-out" option for aquaculture	• Can choose to not participate in aquaculture if a state does not want to • Federal government shouldn't force it on a state

4.1.4 Site selection

Interviewees were asked what characteristics sites should have in terms of environmental factors and tenure of a lease or permit. As shown in Table 8, responses to this question consisted of criteria that fell into the three general categories of tenure, planning and environmental needs. There was no general consensus on appropriate tenure for offshore aquaculture facility permitting or leases, and opinions varied between and among

interviewee groups concerning the minimum amount of time necessary for an operation to turn a profit. One interviewee stated that initial planning for offshore aquaculture must determine whether development of the industry is in the national interest, and is a good use of public resources before any site selection is carried out at all. All other interviewees operated on the assumption that development of offshore aquaculture in the United States is to the national (and some also agreed global) benefit. Interviewees in the industry and agency categories expressed the opinions that planning must shift from the status quo, which operates on a case-by-case and permit-by-permit basis to a more comprehensive and federal-level framework in order to have national guidelines and consistency between projects.

Tenure

Generally agency personnel, industry personnel and research personnel felt that leases and permits should have at least a 20-year minimum in order to make offshore aquaculture a viable industry that is attractive to investors. However, within these three categories opinions varied from a necessary 20-year minimum tenure for site leases to a minimum 60-year tenure, which would make a facility eligible to apply for grants available from the United States Department of Agriculture. One interviewee in the industry category stated that leases should run until the owner of the facility ends production at that location or there is a permit violation. An alternative opinion offered by an interviewee in the research category stated that while minimum site leases should be 20-25 years, leasing could be done incrementally, with leasing of a site of X area

originally, and expansion of the site as the facility shows that it can manage effects of its production.

In disagreement with the opinions stated by industry, agency, and research interviewees, political interest interviewees generally felt that the current level of research is not adequate to support environmentally safe implementation of a system for 20-year leases. It is their belief that site permits should either not be issued at all until adequate research is conducted, or that lease tenure should be minimized to 10 years in order to track environmental impacts and make any changes necessary without approving a 20-year permit. In essence there is conflict of opinion regarding the amount of environmental precaution necessary in the development of offshore aquaculture, and the ability of the industry to balance environmental precaution with turning a profit. While all interviewee categories agree that precaution must be taken to avoid negative impacts, the difference of opinion lies in the degree of precaution necessary, and the amount of trust associated with research that has been conducted and reported. Industry personnel feel that precaution is necessary and is inherent to the nature of their work, which relies on healthy ecosystems and healthy seafood products. It was stated by the majority of industry personnel interviewed that it is in their best interest to maintain a healthy ecosystem. Research and industry personnel interviewed stated that their work has shown that with adequate monitoring, and effective planning and implementation, offshore aquaculture operations can take place sustainably with little to no impact. However political interest interviewees showed distrust of the research that was cited by research and industry

interviewees, and stated that more research needs to be done before they can be comfortable with the approval of permits and leases with tenures of twenty years or more.

Planning

Many of the ideas offered by interviewees for planning of site selection referenced ideas that were stated in the discussion of potential use conflicts. These include the use of Marine Spatial Planning for designation of offshore aquaculture sites as well as the concept of a government-produced, large-scale EIS noting appropriate zones for offshore aquaculture facilities. Both of these ideas would provide federal guidance concerning the siting of offshore aquaculture facilities, and would take some of the burden off the applicant, making entry into the industry more appealing to potential applicants. Interviewees in all categories expressed the opinion that any permits to operate offshore aquaculture facilities should include clauses stating that violations of the permit conditions will result in forfeiture of the right to produce seafood products. It was also widely agreed among interviewees that there should be regulatory provisions built into any federal framework that is established to guard against the practice of operating a facility in an unsustainable manner, abandoning it and relocating to another site in United States federal waters.

Some proposed planning criteria offered by interviewees took the potential social impacts of offshore aquaculture into account, such as planning for coastal infrastructure development. It was noted by one interviewee in the industry category that sites for offshore aquaculture must also take into account the availability of shore-side

infrastructure such as hatcheries, processing plants and maintenance facilities when determining appropriate areas for facilities. Proximity to necessary shore-side infrastructure can have a large impact on the amount of energy used in transportation of fish and feeds between shore and the facility in federal waters.

Environmental

Along with ideas and opinions regarding lease tenure and planning for site selection, interviewees also offered opinions on types of environmental standards that should be accounted for in selection of sites for offshore aquaculture. All categories agreed on the need for sites to have appropriate depth, current, substrate, and surface conditions for operation of offshore aquaculture facilities. It was noted by interviewees in industry and research categories that specific environmental conditions necessary for efficient production will depend on what type of species is being raised at the facility. Interviewees in the research and industry categories noted the need for large enough sites to accommodate the mixing zones necessary for offshore aquaculture facilities. These interviewees noted that as long as the mixing zones directly abutting the facilities are adequately monitored, no negative impacts will occur outside of the mixing zones. Interviewees in all four categories also noted that facilities should not be located within close proximity to each other until more research has been done on potential cumulative impacts and the size of necessary mixing zones has been determined.

Table 8. Common Themes in Offshore Aquaculture Site Selection

Site selection category	Interviewee ideas and proposed criteria

Tenure	• Conflict of opinions
	  o 10-year leases at the beginning.
	  ▪ Shorter is too short for investors
	  ▪ Longer is too much of an environmental risk
	  o 20-25 year tenure
	  o 60-65 years tenure for application for DOA loans
	  o Lease should run until owner wants to abandon facility or there is a violation of permit conditions
	• Incremental leases
	  o Can lease X area for set amount of time
	  o If sustainable and has low environmental impacts scale up to larger area
	• Opposing opinion
	  o 20 years is too many if untested

Planning	• Must determine if offshore aquaculture is a good use of a public resource
	• Avoid case-by-case and permit-by-permit leasing
	• Pre-evaluated sites for aquaculture
	  o Marine Spatial Planning offshore aquaculture zones
	  o Large scale EIS to determine impacts of offshore aquaculture in a given area.
	  ▪ Once completed and accepted, can develop facilities within the given area according to the guidelines of the EIS
	  o Site selection not solely the responsibility of the operator
	• Plan for use conflicts current and future
	• Must have access to coastal infrastructure
	  o Hatcheries
	  o Ports
	  o Processing facilities

Environmental needs	• Current • Depth • Surface conditions for accessing facilities • Based on needs of species being raised • Measure impact outside of mixing zone • Widely spaced sites

4.2 Impacts of economic factors on offshore aquaculture development

When asked to what extent they felt economic factors were influencing the development of offshore aquaculture in the United States, interviewee responses fell into five main categories. Nearly all interviewees cited the intersection between regulatory uncertainty and economic investment as an influence on offshore aquaculture development. Many stated the opinion that the current lack of regulatory certainty creates a disincentive for entry into the industry, as well as a disincentive for investors who see investment as too risky without clear regulatory guidelines and a clear tenure for site leasing. It was the opinion of many interviewees that once a federal regulatory framework for offshore aquaculture is in place economics will be the major driving force behind offshore aquaculture development in the United States. It was stated simply by an interviewee in the agency category that if the economics of the industry do not work, no one will do it. It was widely agreed among interviewees in the agency, industry, and research sectors that if a private company wants to take a financial risk and invest in offshore aquaculture it should not be discouraged, but that the current lack of regulatory certainty is a strong deterrent to those who would otherwise invest in the industry. This sentiment was summed up in a comment an interviewee in the research category who noted that "People are willing to invest in offshore aquaculture, they're just not willing to invest in an unsure regulatory framework."

While the majority of interviewees expressed the opinion that the economic viability of offshore aquaculture would be determined by the regulatory environment that is established, it was the opinion of one interviewee in the political interest category that

offshore aquaculture in the United States is not economically viable and should not be pursued. This interviewee stated that various federal grants have been issued for research and development projects relating to offshore aquaculture, but the industry has not become sustainable on its own. It was the opinion of this interviewee that this, along with competition from foreign markets, pointed to the inability of the United States to maintain a self-sustaining offshore aquaculture industry.

Interviewees in the agency, industry, research and political categories cited the need for development of offshore aquaculture in the United States as imperative if we intend to keep consuming seafood. It was agreed upon by all interviewees that wild-caught fisheries in the United States will not be able to sustain the growing demand for seafood and if seafood is going to be consumed in the United States it will eventually need to be supplemented with aquaculture products. Some interviewees in the industry category cited the increase in affluence of some countries such as China, which recently became a net importer of seafood as opposed to a net exporter. This would change the global market for seafood and could impact the ability of the United States to continue to import seafood cheaply.

Also cited by interviewees in all four categories was the potential for offshore aquaculture to help lower the current trade deficit the United States is facing. Interviewees in each category noted that the DOC has an interest in lowering this deficit, and that because of this interest, the trade deficit is an economic driver for development of the industry. Some interviewees believed that offshore aquaculture could lower the

deficit by contributing seafood to the global market, eventually helping the United States become a net exporter of seafood as opposed to a net importer. Others stated that the United States is at an economic disadvantage for development of the industry, and should focus its resources elsewhere in order to lower the trade deficit. An area of concern which was noted by two interviewees was the ability of a domestic aquaculture industry to compete with prices of imported seafood if species produced domestically are aimed at replacing imported seafood rather than supplementing it. These interviewees stated that stricter environmental standards in the United States may lead to higher production costs which will be reflected in the cost of domestically produced seafood, making consumers less likely to purchase it.

An ethical component to the economics of offshore aquaculture development was raised by interviewees in agency and industry positions who noted the externalized environmental and social impacts from importation of seafood products by the United States. As stated by these interviewees, seafood consumption in the United States is a luxury as opposed to some developing countries that would greatly benefit from the protein provided by seafood, but export their products because there is a demand for it. These interviewees stated that due to the nutritional needs of developing countries that export the majority of their seafood, it is morally imperative that the United States develop offshore aquaculture as a way to meet rising demand and allow countries that traditionally export seafood to begin to include it in their own domestic markets.

As is noted in Section 2.2.1, interviewees in both the agency and industry sectors cited the need to maintain working waterfront infrastructure. It was noted by these interviewees that products from offshore aquaculture facilities will allow processing plants to continue operating despite the decrease in wild caught fishery products, which will positively impact not just processors but distributors as well. These interviewees cited the need to maintain working waterfronts to preserve jobs, identity, and history of coastal communities.

Table 9. Influence of Economic Factors on Offshore Aquaculture Development

Economic influencing factor	Detail

Regulatory system and economic development	• Once site selection and permitting system finalized, economics will be the major driver for offshore aquaculture development
	• Economics make the ultimate decision
	  o Driven by the regulatory framework
	  o Investment in an unsure regulatory framework not economically responsible

Trade deficit as driver	• $10 billion trade deficit in seafood • 80% of seafood imported • 50% of imported seafood is from aquaculture operations
Development imperative	• Need to maintain working waterfronts • If commercial fishing is going to continue, must be supplemented by aquaculture • If Americans want to continue to eat seafood it will need to come from aquaculture operations • Wild fisheries will not sustain the demand
Competition with foreign seafood imports	• Will be difficult for United States to compete with imported seafood due to cost • Ethical aspect of importing seafood and impact on exporting countries
Risk	• If economic risk is too high, investors will not invest • If not looking economically viable, people will not pursue offshore aquaculture • Private equity and investment needed to get offshore aquaculture moving forward • If a private company wants to take the risk, it should not be discouraged o Regulatory system will shut down an operation if it is having a negative impact

4.2.1 Role of Government in the Economics of Offshore Aquaculture Development

It was the opinion of the majority of interviewees that the government should have a limited role in the development of offshore aquaculture in the United States. It was generally agreed among interviewees that the government's role in the economics of offshore aquaculture should consist of creating a federal framework for offshore aquaculture and eliminating the regulatory and economic barriers to entry into the industry. As mentioned earlier, these barriers create a financial burden on potential entrants in the form of time and financial resources spent navigating the current fragmented permitting process. Interviewees in each category expressed the belief that the industry must be self-sustaining and should not rely on government subsidies to maintain its viability. Subsidies were viewed by the majority of interviewees as perverse incentives that support unsustainable industries and practices. It was further agreed by the majority of interviewees that while government subsidies did not have a place in the long-term sustainability of the industry, they would have a benefit in the short-term research and development stage. Interviewees in all categories cited the need for government funding to assist with basic research and monitoring. Types of research suggested as candidates for government funding are listed in Table 10. It was also noted by interviewees in the industry and research categories that government funding for academic partnerships with research facilities and technology development facilities has been immensely helpful in the past and could be highly beneficial again.

Another type of initial governmental involvement noted by interviewees was the potential for retraining programs and government incentives for former wild-catch fishermen who

may have lost income or employment as a result of efforts to lower the number of fishing vessels as a way of curbing overfishing. The opinion was offered by interviewees in agency and industry categories that commercial wild-catch fishermen can quickly be retrained and are already accustomed to spending time at sea and handling seafood. One interviewee in the research category stated that creating tax breaks or credits could provide incentive for potential entrants to the industry, while other interviewees in the agency and research categories offered the opinion that various types of grants and loans could be used for aspects of the research and development stage of the industry. While the majority of interviewees expressed their opinion as stated above, one respondent stated the opinion that government funds should be used elsewhere, and that past government funding for offshore aquaculture has not led to the successful development of the industry. This interviewee, while not citing examples of loans to the industry, stated the opinion that despite the regulatory barriers to development of the industry, the economics of offshore aquaculture development in the United States show that it is not a viable option, and offered the opinion that federal resources should be focused on other types of aquaculture.

Table 10. Role of Government in Economics of Offshore Aquaculture

Type of government action	Details

Basic research and monitoring	• Environmental insurance
	  o Monitoring
	  o Ecosystem modeling
	• Cage design and technology development
	• Alternative feeds
	• Species research
	  o Demonstrate types of viable species
	• Infrastructure development
	• Baseline research for siting needs
	• Foster academic partnerships through grants and funding for R&D
	  o Historically prevalent

Subsidies	• Subsidies are perverse
	  o Tend to push development in unsustainable directions
	  o Industry needs to remain self-sustaining and financially viable in the long-term
	• Subsidies are beneficial
	  o subsidize basic research and training for former commercial fishermen

Incentives	Positive
	• Get commercial fishermen to look more closely at offshore aquaculture as an option
	  o Commercial fishermen in the best position to start developing offshore aquaculture
	  o Incentives for commercial fishermen to switch to offshore aquaculture
	• Tax credits for investors
	• Tax breaks potential
	• Grants and loans similar to NIST and land-grant programs
	Negative
	• Government has been promoting offshore aquaculture for the last 20 years with little to show
	• Federal subsidies could go elsewhere

4.2.2 Potential for net economic benefit to the nation

When asked whether they believed a fully realized offshore aquaculture industry would be to the economic benefit of the nation, interviewee responses fell into three categories as seen in Figure 3. Those who answered with a definitive yes were agency, industry, and

research personnel, the two less definitive yes answers were from one interviewee in an agency position and one interviewee in a political interest group, and the definitive no was an interviewee in a political interest group.

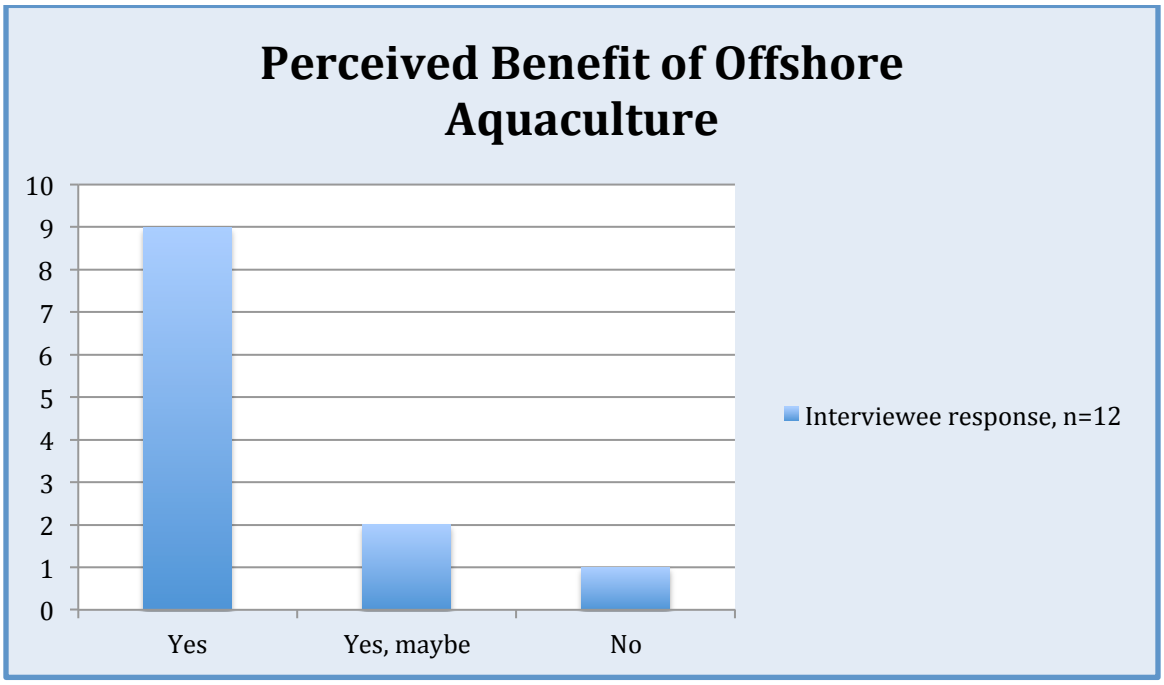

Figure 3. Perceived Benefit of Offshore Aquaculture

Reasoning for the varying responses sum up the opinions of interviewees regarding influence of economic factors on the development of offshore aquaculture that have been discussed earlier in this section. The reasoning and detail given by those interviewees who stated that they believe a fully realized offshore aquaculture industry in the United States would be to the economic benefit of the nation echo opinions shared regarding economic drivers in the development of offshore aquaculture. The rising demand for seafood globally and at the national level is cited, as is the need to produce seafood domestically rather than rely on imported products to fulfill domestic demand.

Interviewees noted the need to even the current trade imbalance in seafood in the United States as well as creating and protecting jobs, assuring quality in seafood, and assuring adequate environmental protection.

The two interviewees who gave a less definitive yes response both stated that offshore aquaculture has the potential to have a net economic benefit to the nation, but at this point they believe that more research is necessary before a definitive answer can be given. It was the opinion of these interviewees that there are still too many legal and regulatory unknowns and not enough scientific research to say for certain that offshore aquaculture in the United States would be beneficial.

The interviewee who offered the opinion that offshore aquaculture would not have a net benefit to the United States stated the opinion that development must follow one of two potential paths. The first potential method of aquaculture production noted in this response was that of seafood producers in countries who use large amounts of chemicals and antibiotics in clustered cages. The interviewee noted the negative environmental impacts from this type of development as well as concerns over quality of seafood products. The other option stated by this interviewee was a model with fewer antibiotics, fewer chemicals, and fewer but larger fish. It was then stated that this method, while not releasing as many chemicals and antibiotics into the environment would raise larger fish, which produce more waste and require more feed, thus having a similarly negative outcome. It was also the opinion of this interviewee that this model would produce larger

fish that would not address the rising demand for seafood, and would instead cater to a niche market for sushi grade products.

Table 11. Economic Benefit of a Fully Recognized Offshore Aquaculture Industry

Offshore aquaculture to the economic benefit of the nation?	Reasoning	Details
Yes	Alternative is not producing seafood domestically and remaining a net importer of seafood	• Developing countries will buy more seafood as they become more wealthy • Countries producing aquaculture seafood will sell to themselves as they become more wealthy • Issue of food security in the United States
		• If the United States continues to increase regulation, won't be able to afford seafood any more
	Address the trade imbalance	• Reduce the United States deficit from seafood imports
	Job creation	• Would add a new industry with jobs to fill • Could provide jobs to commercial fishermen

	Would work with commercial fishermen	• Not a replacement for the commercial fishing industry
		• Can work alongside each other
		  o Both have similar understanding of the need to make a living
		  o Can work together to plan and regulate

	Trickle-down effect for associated industries	• Industry, processors, distributors, buyers, consumers • Science and support industries • Technology industry • Infrastructure • Working waterfronts bolstered o Ports, docks, processing plants
	Quality	• Food quality • Food security • Food sustainability

	Ecosystem services	• Cages can provide ecosystem services
		  o Aggregating devices
		  o Excess feed benefits wild fish as well

Continued: Economic benefit	Reasoning	Details
Yes, maybe	Potential to be economically beneficial	• Need more analysis • Depends on how regulations and permitting proceeds • Depends on species regulations o Can't farm species that are commonly wild caught because would result in commercial fisheries job loss and no net gain
No	Will try to follow competitor's model **OR**	• Heavy use of antibiotics and chemicals • Clustered cages
	Cleaner model	• Fewer antibiotics and chemicals • Fewer fish, but larger size • Large amount of fish meal and oil necessary • Large fish produce more waste • Creates expensive fish sold at sushi grade o The need for larger sushi grade fish different market niche from commonly imported species

4.3 Impacts of political factors on offshore aquaculture development

4.3.1 Stakeholders and positions

All interviewees were asked to state who, in their opinion, were the most important stakeholder groups involved in offshore aquaculture and how their positions have influenced the development of the industry. Responses are summarized in Figure 4 below. As shown, there was a near consensus on the involvement of environmental NGOs in the development of offshore aquaculture. The majority of interviewees offered the opinion that environmental NGOs have influenced the development of offshore aquaculture by creating impediments to growth of the industry. Interviewees in regulatory, industry, research and political interest categories noted efforts by

environmental NGOs to slow development of offshore aquaculture through information dissemination, litigation, and by taking an overly precautionary standpoint on regulation. It was stated by interviewees in agency, industry and research categories that information disseminated by NGOs is often misleading and not based in fact in order to sway its intended audience towards opposition to offshore aquaculture development. Interviewees in these categories also noted suits brought against NMFS by environmental NGOs looking to halt development of offshore aquaculture in the United States. Interviewees in the industry and research categories also offered the opinion that the precautionary approach to development of offshore aquaculture adopted by environmental NGOs was overly cautionary and not based in rational thought. As noted earlier, interviewees cited the NSOAA of 2009 and 2011 as outlining a precautionary approach to offshore aquaculture development that built precaution into regulations in a way that they felt would inhibit adaptive management in the industry. A differing opinion of the NSOAA was offered by an interviewee in the political interest category who stated that the bill took an adaptive approach to regulation of offshore aquaculture and provided a framework for research to be conducted in order to build necessary environmental safeguards into federal regulation.

Six of twelve interviewees offered the opinion that the aquaculture industry was a strong stakeholder in the development of offshore aquaculture. It was stated by one interviewee that the aquaculture industry was an influential stakeholder because of its vested interest in the success of the industry, while other interviewees citied work done by the industry

to obtain permits to conduct research projects, educate the public and other stakeholders about offshore aquaculture, and to support or oppose proposed legislation.

Six of twelve interviewees stated the opinion that commercial fishermen were important stakeholders in the development of offshore aquaculture. These interviewees were in the agency, industry, research and political interest categories. Two interviewees in the industry and research categories noted that the seafood industry as a whole, including wholesalers, buyers, grocery stores and restaurants, is also a stakeholder due to the number of jobs created by the industry. It was stated by interviewees in the agency, industry, research, and political interest categories that commercial fishermen are concerned about competition with aquaculture products and the potential for their livelihoods to be diminished by lowered seafood prices if market supply increases, however they have not been very actively involved in the controversy. An interviewee in the agency category also noted that commercial fishermen are concerned about the potential for disruption of migratory patterns of some fish if aquaculture facilities are sited in some specific areas. This interviewee went on to state that most of the concerns of commercial fishermen are not based in fact, and instead are based on misinformation from NGOs opposed to offshore aquaculture development.

Five interviewees representing all four categories gave the opinion that the federal government and regulators are important stakeholders in the development of offshore aquaculture in the United States. These interviewees generally offered the opinion that the federal government needs to put more focus on development of the industry. It was

the opinion of an interviewee in the industry that the federal government's policy on promotion of offshore aquaculture has been "lip service" so far, and if NOAA and the DOC are serious about promoting offshore aquaculture they need to switch priorities and lower the regulatory burdens present for entry into the industry. Again noted by one interviewee was the vested interest of the DOC in decreasing the United States trade deficit in seafood and would like to use offshore aquaculture as a way to address the issue. This interviewee stated the opinion that the DOC knows it cannot rely on wild-caught fisheries to close to deficit so it will focus on aquaculture production instead.

Three interviewees from the industry, research and political interest categories noted the stakeholder position of seafood consumers in the development of offshore aquaculture. Interviewees from the industry and research categories offered the opinion that consumers are stakeholders in that they comprise the demand for seafood in the United States. The fact that the public in the United States creates demand for seafood makes any consumer of seafood a stakeholder. An interviewee in the political interest category offered the opinion that consumers who are interested in buying sustainable seafood often see aquaculture as a threat, and are stakeholders in that they are interested in consuming only sustainably harvested seafood. An interviewee in the industry also offered the opinion that consumers are generally uneducated about the seafood they are purchasing, and are easily swayed by misinformation being given to them by NGOs regarding the sustainability of seafood from aquaculture practices. Similar to the idea of consumers being stakeholders, three interviewees in the agency and industry categories offered the opinion that the general public had a stake in the development of offshore aquaculture.

Interviewees in the industry and agency categories stated that the general public, like seafood consumers, is often uneducated with regard to the seafood they are purchasing, and are very easily swayed by misinformation from NGOs who are opposed to offshore aquaculture development. An interviewee in the industry category also offered the opinion that the general public is a stakeholder in that they create a demand for protein from seafood, and other sources. In essence, the public is inherently a stakeholder in the development of offshore aquaculture due to the need for basic nutrients.

Two interviewees in the agency and political interest categories noted that feed suppliers, and support industries are also stakeholders in the development of offshore aquaculture. The interviewee in the political interest category noted that the soy industry has shown interest in investing in offshore aquaculture due to the potential need for increased feeds for fish being raised. Citing the controversy over the use of smaller "feed fish" as sources of feed for farmed fish, this interviewee noted that soy producers have shown interest in producing alternative feeds for offshore aquaculture facilities. An interviewee in the agency echoed this opinion stating that feed developers and feed ingredient suppliers are interested in the development of offshore aquaculture as a potential source for their products. It was also noted by this interviewee that support industries such as boat maintenance facilities, vessel equipment suppliers, and technology maintenance industries would have an interest in the development of offshore aquaculture as a potential new source of income.

Two interviewees offered the opinion that state and federal legislators are stakeholders in the development of offshore aquaculture. An interviewee in the research category offered the opinion that federal and state legislators are supposedly regulating the resource for the public good, however they have to protect their own jobs and have often defaulted to calling for more research before taking specific action due to the controversy surrounding development of the industry. This interviewee also noted that legislators at the federal level have the power to pass bills and are therefore extremely important stakeholders. The interviewee in the industry category noted that state legislators are stakeholders in that they have the job of balancing economic growth with environmental impact in their states and that they have the political power to bring offshore aquaculture to state and federal agendas and can be very influential either in support of or in opposition to offshore aquaculture development.

One interviewee in the industry offered the opinion that coastal communities are stakeholders in the development of offshore aquaculture by stating that these are the people who will be directly affected by changes to social systems from offshore aquaculture development. It was stated that working waterfronts would be bolstered by the addition of offshore aquaculture products to processors and distributors, the maintenance of technology and vessels supporting local businesses. It was also noted by one interviewee in the industry category that other ocean users are also stakeholders in the development of offshore aquaculture in that their use of the ocean must also remain intact.

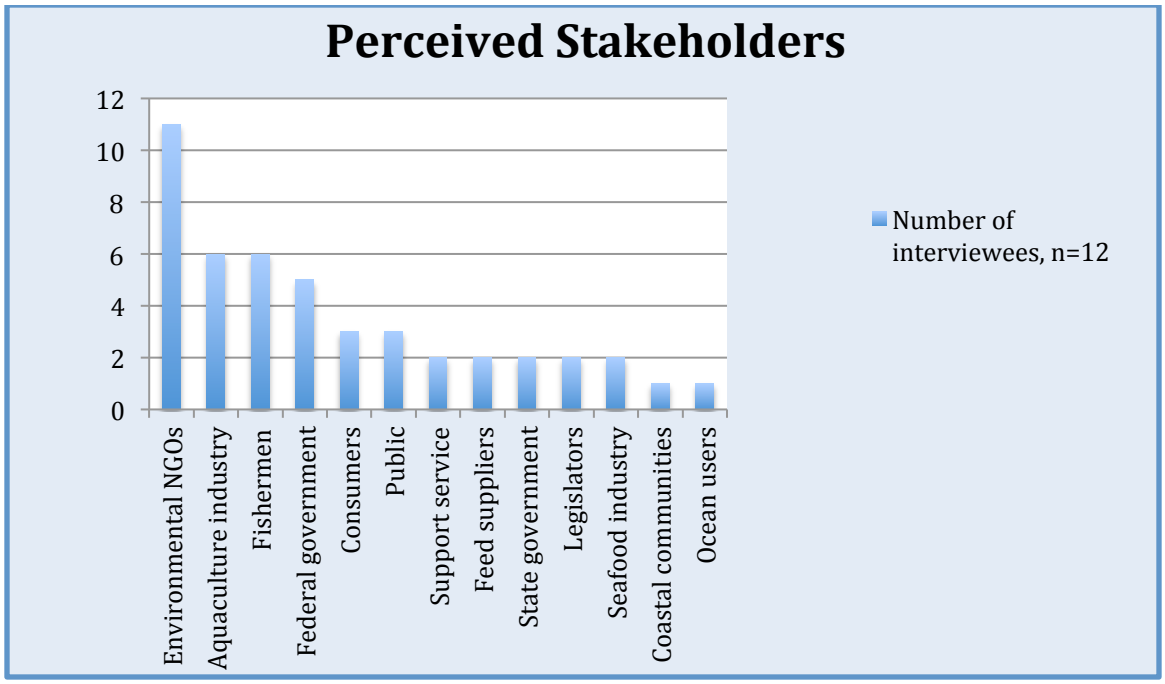

Figure 4. Interviewee Perceived Stakeholders by Number of Mentions

4.3.2 Controversies

Interviewees were asked to identify and describe what, in their opinion, are the main controversies surrounding the development of offshore aquaculture in the United States. Not surprisingly, their responses closely mirrored the responses regarding stakeholders and their positions on the development of offshore aquaculture. The most common controversy mentioned by interviewees across all categories was the discussion of environmental impacts of offshore aquaculture. One interviewee in the political interest category noted the potential for environmental impacts from offshore aquaculture, listing potential escapes, genetic modification of species, water quality, and exploitation of stocks of feed fish as examples of impacts. Seven of twelve interviewees noted the influence of environmental NGOs on the development (or lack thereof) of offshore aquaculture. Interviewees in all four categories offered opinions that environmental

NGOs have provided misinformation in an attempt to sway public opinion toward opposition to offshore aquaculture through exaggeration of potential environmental impacts. One interviewee in the industry category stated that while some of these environmental impacts were potential threats years ago, technology and understanding of industry needs has evolved to the point where these potential impacts can all be easily and affordably managed by offshore aquaculture facilities. An interviewee in the political interest category offered the opinion that offshore aquaculture is often compared to inshore salmon aquaculture and portrayed in a negative light due to environmental issues experienced in the salmon farming industry. This interviewee went on to say that this comparison is an inaccurate representation of offshore aquaculture, yet opponents of offshore aquaculture to influence public opinion often use it. It was further stated by two interviewees in the agency and research categories that the "real" reason for opposition to offshore aquaculture by environmental NGOs is the belief that the ocean is a common pool resource and should not be used for private gain by offshore aquaculture companies. The interviewee in the research category stated that rhetoric used by environmental NGOs regarding environmental impacts of offshore aquaculture is simply a way to attract public support for their efforts to keep private industries from using ocean resources to make a profit.

Other controversies mentioned included market competition with wild-caught seafood and use conflicts, which were each mentioned by one interviewee. Market competition was noted by an interviewee in the agency category who did not elaborate on what types of controversies were associated with market competition, but it is assumed that this

interviewee was referring to the concerns discussed previously concerning economic impact of increased seafood supply to wild-caught fisheries. Use conflicts were listed as a controversy by an interviewee in the political interest category who stated the opinion that this controversy is based in fear of change in the seafood industry sector on the part of commercial fishermen, who are concerned that aquaculture could become a stronger presence in the industry and push them out of work.

4.3.3 Environmental and social standards

Interviewees were asked to state what types of standards they would like to see in federal regulation of offshore aquaculture with regard to regulating social and environmental impacts. Responses generally fell into the categories of environmental protection and minimization of potential social impacts. Other standards mentioned were necessary transparency built into management of offshore aquaculture facilities, and the necessary inclusion of regional Fishery Management Councils in regulation of offshore aquaculture.

Environmental

Seven of twelve interviewees from all four categories offered opinions of specific types of environmental standards that should be addressed by a federal regulatory framework for offshore aquaculture in the United States. It was noted by interviewees in agency, industry and research categories that stringent monitoring of baseline and post-deployment impacts of a facility must be carried out in a transparent way. Two of these interviewees, from the industry and research categories, stated that monitoring should be

done both internally by the offshore aquaculture company as well as externally by government personnel.

It was also stated by an interviewee in the agency category that offshore aquaculture regulations should contain language encouraging the long-term sustainability of the industry, rather than short-term viability only. Such standards would include sustainable sources of feed, as well as address selection of sites for offshore aquaculture that are sustainable in the long-term, implying that both use conflicts and potential environmental impacts are minimized. One interviewee in the industry stated that if a site is chosen well it can minimize environmental impacts of the facility. Interviewees in the industry and research categories offered the opinion that species native to the area should be the only ones allowed in offshore aquaculture facilities, and that modeling should be done to determine potential impacts of escaped fish on native wild stocks. Interviewees in the industry and research categories offered the opinion that no impacts should be measureable outside the mixing zones of offshore aquaculture facilities, with one exception being made for a higher concentration of wild fish aggregating outside of the cages. It was noted by one interviewee in the research category that many of these standards already exist through the current permitting process, and will need to be included in any new legislation passed in order to maintain compliance with other applicable laws and regulations.

Interviewees in the political interest category deferred their opinions to the NSOAA of 2009 and 2011 stating that standards outlined in this bill reflected their views regarding

precautions necessary in a federal regulatory framework. This bill is discussed in Section 2.1.3.

Social

Interviewees in the industry and research categories addressed social standards appropriate for offshore aquaculture regulation by stating that impacts to social systems from offshore aquaculture development should be minimized. However the ocean is a common resource and access to it should not be denied to a specific type of industry because another industry is concerned about the potential impact. An interviewee in the research category stated the opinion that commercial fishermen will not see a large change in the market price of seafood due to the already prevalent imported seafood, and the setting of prices of seafood by the global seafood market. It was this interviewee's opinion that the addition of seafood from domestic offshore aquaculture would have minimal impact on the market price of seafood.

As with environmental standards, interviewees in the political interest category deferred their opinions to the NSOAA of 2009 and 2011, which accurately reflects their views on the degree of precaution that should be built in to a federal regulatory framework for offshore aquaculture.

5.0 Findings

Regulatory, economic, and political factors were the focus in this inquiry into the reasons for the lack of development of offshore aquaculture in United States Federal waters. These areas emerged through a review of available literature. Three focusing questions were identified.

1. To what extent do regulatory factors influence the development of offshore aquaculture in the United States?
2. To what extent do economic factors influence the development of offshore aquaculture in the United States?
3. To what extent do political factors influence the development of offshore aquaculture in the United States?

In addition to the literature review, semi-structured interviews were conducted with agency, industry, research, and political interest personnel familiar with the issue. These interviews provided insight into the personal opinions and experiences of high-level personnel associated with the development of offshore aquaculture in the United States.

5.1 Influence of regulatory factors

A review of the literature pertaining to offshore aquaculture development showed that considerable information exists concerning the limited ability of the current piecemeal regulatory system to guide development of the industry. Both studies and legal opinions focus on regulatory factors influencing the development of offshore aquaculture in United States federal waters, with the majority specific to the Gulf of Mexico EEZ (Fletcher 2001, Fletcher 2004, Cicin-Sain 2005, Showalter 2008, Showalter 2009).

Findings of this thesis are consistent with Fletcher (2004) who found that the current regulatory regime is inadequate due to the failure of applicable laws and regulations to specifically address regulation of offshore aquaculture. Fletcher documented that the lack of a comprehensive regulatory structure was often cited as a cause for the lack of development of domestic offshore aquaculture, and the lack of federal regulation dealing explicitly with offshore aquaculture is the main culprit of legal and regulatory inefficiency (Fletcher 2004). These findings are echoed by Cicin-Sain (2005) who notes various administrative and private level recommendations for development of a lead federal agency for offshore aquaculture regulation rather than maintaining the status quo. Legal opinions issued by the National Sea Grant Law Center to also comment on the lack of specificity of applicable laws and regulations (Showalter 2008, Showalter 2009). Attempts have been made to establish NOAA as the lead federal authority for regulation of offshore aquaculture (NOA Act 2005, NOA Act 2007), however the regulatory environment for offshore aquaculture development in the United States remains a fragmented framework of regulations that are only semi-applicable to offshore aquaculture and inadequate for the development and the proper regulation of the industry.

While there are numerous laws and regulations with aspects that are applicable to offshore aquaculture regulation, none was designed with offshore aquaculture specifically in mind. The lack of action by congress to name a lead federal agency for offshore aquaculture regulation has also had a strong influence on the ability of the industry to develop. This has led to an unstable regulatory environment that presents disincentives to potential entrants to the industry. It also serves as a disincentive to potential investors

who are unwilling to risk their return on an investment due to an uncertain permit and lease tenure for a facility.

Use conflicts and siting issues are commonly viewed as potentially influencing the development of offshore aquaculture. Because there is still no federal regulatory framework for offshore aquaculture in the United States however they are most commonly viewed by interviewees as potential future threats. The idea that use conflicts are perceived rather than real was a common theme among interviewees a result of misinformation from opponents of the industry. Those who believed that use conflicts were real generally also felt that with proper planning and implementation conflicts could be avoided, leading to the conclusion that use conflicts are not a major impediment to the development of offshore aquaculture in the United States.

5.2 Influence of economic factors

Findings of this study showed economic influences on offshore aquaculture at varying scales. At the global level there is a rising demand for seafood, and a general consensus among interviewees that wild-caught fisheries will not be able to meet this demand and aquaculture will be necessary to supplement wild-caught fishery products. Interviewees and outside sources recognized that countries that have traditionally exported seafood to the United States and other countries are gaining in affluence, and some have already sifted from net exporters to net importers, while others are heading in that direction. This trend raises the issue of food security in the United States, and led many interviewees to state that the United States must increase its domestic production of seafood if it intends

to continue to consume it at the current rate. The status of the United States as a net importer of seafood has also caused a significant trade deficit at the national level, which acts as a driver for the development of offshore aquaculture. The majority of interviewees expressed the opinion that offshore aquaculture will be the most sustainable way to increase domestic production of seafood and cited the comparative advantages that the United States has for development of this type of industry. An opposing opinion expressed the need to focus solely on recirculating enclosed systems instead of offshore development, while another opinion stated the need for an increase in domestic aquaculture production of all types; offshore, nearshore, inshore, and onshore recirculating systems.

On a smaller scale, economics influence the development of offshore aquaculture by creating a barrier to entry into the industry. As noted in the regulatory findings, the uncertainty of the current regulatory system creates a disincentive for potential investors in the industry. The current framework for permitting offshore aquaculture works case-by-case, with no comprehensive federal regulation to guide the process, and no set tenure for site leasing. Without a set tenure for returns on an investment, it is risky to input capital into a new industry. The current process for obtaining permits necessary for offshore aquaculture has taken applicants from two to five years, and the onus is on the permit applicant to navigate the process. Taking into account the length of time necessary for permits to be obtained, the regulatory uncertainty inherent to the current fragmented regulatory framework, and the amount of time necessary for a new offshore operation to become established and begin to turn a profit, an investor will not begin to see a return on

his/her investment for an undesirably long amount of time. With no federal guidelines to regulate the tenure of lease permits this type of investment is viewed as extremely risky by potential investors.

This study also found that government subsidies are generally only desired for initial research and development of offshore aquaculture. Interviewees in all sectors stated that the industry should not rely on government subsidies to make it economically sustainable, and must be sustainable on its own. Many agreed that the government's priority in offshore aquaculture development should be to streamline the permitting process and foster partnerships between industry and academia in order to produce necessary research. It was generally agreed that streamlining of the permitting process would benefit the development of offshore aquaculture in the ways mentioned in the above paragraph. Types of research and development funding most commonly noted as potential areas for initial government assistance were monitoring and modeling, cage design and technology development, alternative feeds.

5.3 Influence of political factors

This study finds that while there are a broad variety of stakeholders associated with the development of offshore aquaculture development, most political actions are taken by NOAA and political interest groups. Industry stakeholders assert their stance on offshore aquaculture development, however they tend to be more focused on research and experimental projects than entering into the political realm of offshore aquaculture development. NOAA has made attempts to get legislation passed that would designate

the Secretary of Commerce as the lead authority for regulation of offshore aquaculture in the United States, and has issued permits to companies conducting experimental projects. NOAA also released its policy statement on marine aquaculture in 2011, which states its commitment to development of the industry.

NOAA has stated its commitment to the development of offshore aquaculture, however it has been found that political interest groups have also had a strong influence. The majority of political interest groups associated with offshore aquaculture have adopted a supportive position on the development of the industry, but state that it should not be done unless adequate precautions are taken to ensure the protection of the environment. The Ocean Conservancy has taken an active role in the promotion of precautionary development of offshore aquaculture, and numerous other NGOs have made similar statements. Among political interest groups, however, one outlying NGO has had a significant impact on the development of the industry. Food & Water Watch (FWW) has stated its strong opposition to any development of offshore aquaculture, asserting that it is not economically viable, and resources should be used to develop inland recirculating enclosed aquaculture systems which it believes are more economically and environmentally sustainable than offshore aquaculture.

It is the belief of the majority of interviewees in all categories, political interest groups included, that information used by some environmental interest groups is falsely construed and aimed at manipulating the perceptions of the general public to believe that industrial use of the oceans, a common-pool resource, is negative. These groups have

nevertheless been successful at gaining support in opposition to the development of offshore aquaculture, even through lawsuits brought by some of these organizations have not resulted in rulings in their favor. Some interviewees felt that the political atmosphere regarding offshore aquaculture has had a stronger influence on the development of a regulatory framework for offshore aquaculture than findings from research projects conducted by the industry.

While this project focused on federal regulation, many interviewees stressed the importance of state governments in the development of offshore aquaculture. At the state level, government attitudes toward the development of offshore aquaculture tend to reflect the priorities of the state's elected officials and their constituencies, and will be reflected in the state's CZM Plan. These priorities reflect in turn the economic, social and political situation of the state. States can develop their own aquaculture policies, which may outline specific goals and objectives unique to the priorities of their residents. As regulations currently stand, it is wise for any action taken by a party interested in developing an offshore aquaculture project to not only be consistent with federal laws and regulations, but also with the policy of the state whose coast they will be developing. As is discussed in Section 5.1.3 of this thesis, states can invoke the Federal Consistency clause of the CZMA and appeal any federally permitted action that will have an impact on their state's coastal zone. In this way, the coastal states of the United States have a distinct political stake in the development of a domestic offshore aquaculture industry.

6.0 Conclusions and Recommendations

Development of offshore aquaculture in the United States is predominantly influenced by regulatory, economic, and political factors. While some aspects of each category favor development of the industry, for example, rising demand and prices for seafood in the U.S., the dominant thrust of each category to date has been to impede more than favor development. The most commonly cited barrier to development of the industry by the people I interviewed is the lack of a clear, comprehensive federal regulatory framework, and the lack of a lead federal agency with adequate resources to guide and regulate offshore aquaculture. In lieu of a federal regulatory framework, there is a piecemeal system of applicable laws and regulations. However none of these was designed with offshore aquaculture in mind. With the enactment of the NAA in 1980 the Department of Agriculture was designated as the lead federal agency for promotion of aquaculture, and the Joint Subcommittee on Aquaculture was established within the Congress to effectively coordinate aquaculture research and assistance (NAA, 1980). While the NAA granted the authority to coordinate aquaculture research and assistance efforts, it did not create a specific mandate for aquaculture development in the offshore. The NAA mandated that a National Aquaculture Development Plan be created to outline development of the aquaculture industry in the United States, however at the time of enactment of the NAA in 1980, aquaculture activities consisted of mainly freshwater and coastal activities. Offshore aquaculture was not on the horizon. The DOA has promoted traditional types of aquaculture in the United States, however it has not been effective in the promotion of expansion of aquaculture in the United States into federal waters due to its lack of expertise and perhaps interest in the management of marine resources.

As a result, no guidance documents have been created which would assist a prospective developer in navigating through the piecemeal framework of regulations that currently exists. Moreover, most of the regulatory, economic and political challenges to the development of offshore aquaculture have been left unaddressed by federal authorities. It is for this reason that the majority of stakeholders believe that NOAA should be the lead federal agency responsible for development and regulation of offshore aquaculture in the United States. NMFS has extensive experience regulating marine fisheries in the United States EEZ. However attempts by the agency to develop a federal framework for offshore aquaculture have been met with resistance from opponents of the industry. Finally, Congress has not come to agreement on what types of guidance should be offered in a federal regulatory framework for offshore aquaculture.

Underscoring the need for development of a domestic offshore aquaculture regulatory framework are ethical components, one associated with the perceived potential for environmental degradation of United States marine resources, and another associated with the exportation of seafood to the United States from developing countries. As noted earlier, there is strong public perception that the development of offshore aquaculture will result in degradation to marine environments. Many members of the general public who view offshore aquaculture as a potential threat to the natural ecosystem are also of the opinion that it would be unethical to promote its development. This view lends itself to the notion that a regulatory framework for offshore aquaculture should be highly precautionary in order to assure that all potential negative environmental impacts to the marine resources of the United States are managed adequately. It must also be noted

however, that the majority of countries producing seafood to export to the United States do not have environmental regulations as stringent as those applicable to US domestic actions. By continuing to support demand for seafood with imports from countries with less stringent environmental standards, the United States may in effect, be a catalyst for environmental degradation abroad. Many countries exporting seafood to the United States are also in need of protein themselves, yet seafood is exported to the United States as a preferred item of consumption due to the demand. Therefore, along with such social costs, poorly understood environmental externalities are being generated in the producing countries.

While it is agreed by all parties associated with the development of offshore aquaculture development in the United States that precaution is necessary in the formation of a federal framework, an over-abundance of caution in the name of conservation of our own marine resources will prolong the status quo and continue to place environmental externalities on those who are less capable of managing them than the United States, and will continue to create an imbalance of need for protein and available supply in some producing countries.

This thesis outlines recommendations in five stages:

1. Establish a panel of experts to examine and evaluate the need for development of a domestic offshore aquaculture industry
2. Promote inter-agency coordination for implementation of recommendations of the expert panel

3. Educate all stakeholders concerning the findings and recommendations of the expert panel through participatory workshops
    a. Encourage stakeholder participation in discussion of concerns with emphasis on potential solutions
4. Educate the general public concerning the findings and recommendations of the expert panel and stakeholder workshops
5. Draft new legislation reflecting the findings of the expert panel and the stakeholder workshops with the goal of creating an appropriate regulatory framework

A panel of experts in offshore aquaculture should be convened to examine more closely the argument that a domestic offshore aquaculture industry is needed, and to outline a regulatory approach that would provide the necessary guidance to the industry while assuring appropriate levels of environmental protection. This group should include representatives from all stakeholder groups included in Figure 4 of this document, at least one specialist in economics of domestic marine fisheries and international seafood trade, and a minimum of one representative from the Joint Subcommittee on Aquaculture. This panel would evaluate the need for a domestic offshore aquaculture industry, and create a final report outlining recommendations based on their findings.

In order to implement the recommendations of the expert panel, coordination between agencies will be necessary. Since it is the mandate of the Joint Subcommittee on Aquaculture to coordinate and disseminate information regarding aquaculture, the JSA

will oversee coordination of agency efforts and sharing of information between agencies concerning the findings of the expert panel. This coordination will begin to establish the organization of agency specialties with regard to development of offshore aquaculture, and will lead to the potential structure of government authorities over aspects of offshore aquaculture regulation.

With the establishment of a preliminary regulatory structure for offshore aquaculture and coordination of government agencies applicable to offshore aquaculture, it is recommended that stakeholder workshops be held. The purpose of these workshops is to educate stakeholders on the findings and recommendations of the expert panel, and the proposed regulatory structure. These workshops will encourage stakeholders to air their concerns, but will be focused on coming up with potential solutions to address these concerns while keeping in mind the findings and recommendations of the expert panel.

Communication among stakeholders aimed at identifying common interests and shared goals and objectives regarding offshore aquaculture development will be encouraged. This thesis suggests that a rough consensus exists across agency, industry, research and political interest stakeholders with regard to the need for development of offshore aquaculture in the United States. However, as noted by one interviewee, “the devil is in the details.” This interviewee was referring to the question of the amount of precaution necessary for offshore aquaculture to be sustainable in the long-term. The findings of the expert panel will serve as a baseline of unbiased information for stakeholders to discuss in the context of their experiences, opinions and concerns. The output from these

stakeholder workshops will be a report outlining the various views on development of offshore aquaculture, and describing proposed solutions to address concerns that have been aired by participants using the findings of the expert panel as a basis for discussion and decision-making.

Upon completion of the stakeholder workshops, efforts should be made to educate the general public about the findings of the expert panel and the outcome of the stakeholder workshops. This effort should incorporate inputs from all stakeholders involved in the development of offshore aquaculture in order to create a balanced output of information. This stage may prove difficult due to the variation in capacity for information dissemination between stakeholders, however this imbalance can be addressed and negotiated during stakeholder discussions, and a solution can be proposed.

At this stage legislation for federal regulation of offshore aquaculture can be drafted in a way that reflects the findings of the expert panel, and compromises and solutions reached by stakeholders. Once public perception of offshore aquaculture development has begun to reflect the findings of the expert panel and the balanced viewpoints of stakeholders, legislation that also reflects these findings and solutions will have a much higher chance of being signed into law. These regulations for implementation of offshore aquaculture development will provide guidance to those interested in participating in the industry, as well as assurance that concerns have been addressed and included in regulatory measures.

While aquaculture in the United States has been successful in coastal and inland waters, there are advantages to establishment of a unified federal approach to offshore aquaculture as well. In order to develop a federal regulatory framework efforts will first need to be made to determine the need and capacity for offshore aquaculture in the United States, and then to educate stakeholders and the public about these findings. Efforts to create a federal regulatory system for offshore aquaculture may be coupled with broader spatial planning efforts in order to accommodate other uses of United States federal waters such as offshore wind and wave energy production. While there are currently regulatory, economic and political factors influencing the development of offshore aquaculture in United States federal waters, these factors can be discussed and addressed in a productive way that will allow the United States to achieve its potential for production of aquaculture seafood.

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Appendix: Interview questions

Preamble:

The definition of offshore that I am using for this thesis is limited to the Exclusive Economic Zone beyond State waters. I am looking at influences that regulatory, economic, and political factors may have on the development of this industry.

I will be asking questions regarding regulation of offshore aquaculture, economics of offshore aquaculture, and the political environment surrounding offshore aquaculture. There are 3-4 questions in each subject area and a few follow up questions. I expect this interview will last approximately 30-40 minutes. Each interviewee for this thesis will be asked the same set of questions. Please feel free to take any comments "off the record" if you feel they should remain confidential and should not be included in the thesis that will be written using this information. At the end of the interview I will ask how comfortable you are with having your name cited along with the information you have provided, and give you the opportunity to remain anonymous.

As I stated before, I have questions in these three areas; regulatory, economic, and political. Which are you most comfortable starting out with?

Regulatory factors

Question #1 How familiar do you feel you are with current laws and regulations applicable to offshore aquaculture in federal waters?	Follow up if: **Very**	Follow up if: **Somewhat**	Follow up if: **Not at all**
	Question #2 Given what you know about the existing regulatory framework, do you think that it helps or hinders the development of offshore aquaculture? • In what ways? • Is there something you would change about the regulation that would address that?	Question #2 Given what you know about the existing regulatory framework, do you think that it helps or hinders the development of offshore aquaculture? • In what ways? • Is there something you would change about the regulation that would address that? • (If they say "don't know," then ask What are the most important features of	Skip to Question #3
	Question #3 To your knowledge, to what extent are there use conflicts or other types of conflicts that are important to consider in the development of offshore aquaculture?	Question #3 To your knowledge, to what extent are there use conflicts or other types of conflicts that are important to consider in the development of offshore aquaculture?	Question #3 In your opinion what should a regulatory framework for offshore aquaculture have as its goals, and what should it be capable of managing? How important is it to

	• Are you familiar with the federal consistency clause? If **yes**: Do you think that states might apply federal consistency in a way that might inhibit offshore aquaculture? If **no**: The federal consistency clause gives states the authority to mandate that actions that are federally permitted must be consistent with their state Coastal Zone Management Act. • Do you think states would try to use this in a way that would influence the development of offshore aquaculture? (Bring up the Navy or USCG if they don't) (Looking for user conflicts and potential environmental conflicts)	• Are you familiar with the federal consistency clause? If **yes**: Do you think that states might apply federal consistency in a way that might inhibit offshore aquaculture? If **no**: The federal consistency clause gives states the authority to mandate that actions that are federally permitted must be consistent with their state Coastal Zone Management Act. • Do you think states would try to use this in a way that would influence the development of offshore aquaculture? (Bring up the Navy or USCG if they don't) (Looking for user conflicts and potential environmental conflicts)	regulate: • Environmental impact • Social or economic Impacts • Navigational or other spatial use conflicts • Public trust concerns (using ocean commons for commercial purposes) (If they don't bring them up)
	Question #4 If the federal government were to promote the development of offshore aquaculture through a system of site leases, what characteristics should those leases have? • Environment • Tenure	Question #4 If the federal government were to promote the development of offshore aquaculture through a system of site leases, what characteristics should those leases have? • Environment • Tenure	Question #4 If the federal government were to promote the development of offshore aquaculture through a system of site leases, what characteristics should those leases have? • Environment • Tenure

Economic factors

Question #1 How familiar do you feel you are with the economics of offshore aquaculture?	Follow up if: **Very**	Follow up if: **Somewhat**	Follow up if: **Not at all**
	Question #2 To what extent do you feel economic factors are influencing the development of offshore aquaculture?	Question #2 To what extent do you feel economic factors are influencing the development of offshore aquaculture?	Question #2 To what extent do you feel economic factors could impact the development of offshore aquaculture?
	Question #3 Do you think the federal government has a role to play in addressing the economic viability of offshore aquaculture, and what do you think they should do?	Question #3 What effect do you think economic subsidies might have on the development of offshore aquaculture in the United States?	Question #3 What effect do you think economic subsidies could have on the development of offshore aquaculture in the United States?
	Question #4 Do you believe that a fully realized offshore aquaculture industry would be to the economic benefit of this region? The nation? If not, what about it makes it not viable?	Question #4 Do you believe that a fully realized offshore aquaculture industry would be to the economic benefit of this region? The nation? If not, what about it makes it not viable?	Question #4 Do you believe that a fully realized offshore aquaculture industry would be to the economic benefit of this region? The nation? If not, what about it makes it not viable?

Political factors

Question #1 How familiar are you with the stakeholder community surrounding the development of offshore aquaculture?	Follow up if: **Very**	Follow up if: **Somewhat**	Follow up if: **Not at all**
	Question #2 To the extent that you are familiar with stakeholders involved, who are the most important stakeholders, and how are their positions influencing the development of offshore aquaculture? • How influential have these stakeholders been?	Question #2 To the extent that you are familiar with stakeholders involved, who are the most important stakeholders, and how are their positions influencing the development of offshore aquaculture? • How influential have these stakeholders been?	Question #2 To the extent that you are familiar with stakeholders involved, who are the most important stakeholders, and how are their positions influencing the development of offshore aquaculture? • How influential have these stakeholders been?
	Question #3 What in your view are the most important controversies surrounding offshore aquaculture development in the US?	Question #3 What in your view are the most important controversies surrounding offshore aquaculture development in the US?	Question #3 What in your view are the most important controversies surrounding offshore aquaculture development in the US?
	Question #4 What types of standards would you like to see in place for offshore aquaculture with regard to environmental and social impact? If there are any other standards that I have left out that you feel are important would you please list them?	Question #4 What types of standards would you like to see in place for offshore aquaculture with regard to environmental and social impact? If there are any other standards that I have left out that you feel are important would you please list them?	Question #4 What types of standards would you like to see in place for offshore aquaculture with regard to environmental and social impact? If there are any other standards that I have left out that you feel are important would you please list them?

Final summary question

What in your opinion are the main drivers for or against offshore aquaculture in the United States?

Interview follow-up questions

"Who are you" questions:
What is your position in your agency/industry/organization?

How long have you been in your position?

How long have you been working with aquaculture?

How much of your time is devoted to aquaculture issues?

- Offshore aquaculture?

Does your organization have a position on offshore aquaculture, and what is it briefly?

Confidentiality questions:
Is there any information that has been exchanged in this interview that you would like to remain "off the record?"

Is there any information that you wish to have your name or your company/agency's name attached to?