PUBLIC HEARING DRAFT

GENERIC AMENDMENT TO:

THE GULF OF MEXICO FISHERY MANAGEMENT COUNCIL'S RED DRUM, REEF FISH, AND STONE CRAB FISHERY MANAGEMENT PLANS AND THE GULF OF MEXICO AND SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL'S JOINT SPINY LOBSTER AND COASTAL MIGRATORY PELAGICS FISHERY MANAGEMENT PLANS

TO PROVIDE FOR REGULATION OF OFFSHORE MARINE AQUACULTURE

(Including a Draft Programmatic Environmental Impact Statement, Initial Regulatory Flexibility Analysis and Regulatory Impact Review)

DECEMBER 2007

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Acronyms/Abbreviations

ABC	acceptable biological catch
ACOE	Army Corps of Engineers
ADCNR	Alabama Department of Conservation and Natural Resources
AP	advisory panel
APA	Administrative Procedures Act
APHIS	Animal and Plant Health Inspection Service, US Department of Agriculture
B	biomass
$B_{CURRENT}$	current biomass of stock
B_{MSY}	Biomass at MSY
BOD	Biological Oxygen Demand
CFR	Code of Federal Regulations
Council	Gulf of Mexico Fishery Management Council
CPUE	catch per unit effort
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DEIS	draft environmental impact statement
DO	dissolved oxygen
DOC	U. S. Department of Commerce
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFP	exempted fishing permit
EIS	Environmental Impact Statement
ELMR	Estuarine Living Marine Resources
E.O.	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAO	Food and Agriculture Organization (United Nations)
FMP	fishery management plan
F_{MSY}	fishing mortality rate producing MSY
FMU	fishery management unit
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Florida Fish and Wildlife Research Institute
GC	NOAA general counsel
GMFMC	Gulf of Mexico Fishery Management Council
GMMSEP	Gulf of Mexico Marine Stock Enhancement Program
Gulf	Gulf of Mexico
HAPC	Habitat Areas of Particular Concern
HMS	Highly Migratory Species
IFQ	Individual Fishing Quotas
IQA	Information Quality Act
IRFA	initial regulatory flexibility analysis
LDWF	Louisiana Department of Wildlife and Fisheries

MARFIN	Marine Fisheries Initiative
MFMT	Maximum Fishing Mortality Threshold
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MP	million pounds
MPA	Marine Protected Area
MRFSS	Marine Recreational Fishery Statistics Survey
MSAP	Mackerel Stock Assessment Panel
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSST	Minimum Stock Size Threshold
MSY	maximum sustainable yield
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	Same as NOAA Fisheries Service
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
OOA	Open Ocean Aquaculture
OMB	Office of Management and Budget
OCSLA	Outer Continental Shelf Lands Act
OY	optimum yield
PEIS	Programmatic Environmental Impact Statement
ppm	parts per million (e.g., oxygen)
ppt	parts per thousand (salinity)
RA	Regional Administrator of NOAA Fisheries Service
RDSAP	Red Drum Stock Assessment Panel
RFA	Regulatory Flexibility Act
RIR	regulatory impact review
SAFMC	South Atlantic Fishery Management Council
SAV	Submerged Aquatic Vegetation
SBA	Small Business Administration
SEAMAP	Southeast Area Monitoring and Assessment Program
SEDAR	Southeast Data Assessment Review (stock assessment)
SEFSC	Southeast Fisheries Science Center of NOAA Fisheries Service
SEIS	supplemental environmental impact statement
SERO	Southeast Regional Office (NOAA Fisheries Service)
SMZ	special management zone
SPL	saltwater products license (FL)
SPR	spawning potential ratio
SSB	spawning stock biomass
SSB/R	spawning stock biomass per recruit
TAC	total allowable catch
TOC	total organic carbon
TPWD	Texas Parks and Wildlife Department
UNH	University of New Hampshire

USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WSSV	white spot syndrome virus

Programmatic Environmental Impact Statement (EIS) Cover Sheet

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Name of Action

A Generic Amendment to the Gulf of Mexico Fishery Management Council's Red Drum, Reef Fish, and Stone Crab Fishery Management Plans, and the Gulf of Mexico and South Atlantic Fishery Management Council's Joint Spiny Lobster and Coastal Migratory Pelagic Fishery Management Plans to Provide for Regulation of Offshore Marine Aquaculture

Type of Action

(X) Administrative
(X) Draft

( ) Legislative
( ) Final

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Abstract

Demand for protein is increasing in the United States and commercial wild-capture fisheries will not likely be adequate to meet this growing demand. Aquaculture is one method to meet current and future demands for seafood. The Gulf of Mexico Fishery Management Council has authority to regulate fishing in federal waters, including aquaculture. Currently, NOAA Fisheries Service requires an exempted fishing permit

(EFP) to conduct aquaculture in federal waters. This permit is of limited duration and is not intended for commercial production of fish, making aquaculture in federal waters not viable under the current permitting process.

The purpose of this Generic Aquaculture Amendment is to maximize benefits to the Nation by establishing a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico. The Council initiated this action to provide a programmatic approach to evaluating the impacts of aquaculture proposals in the Gulf of Mexico and a comprehensive framework for regulating such activities. The amendment and associated programmatic environmental impact statement (PEIS) are intended to streamline the regulatory process for authorizing current and future offshore aquaculture proposals by providing the Council and NOAA Fisheries Service the information required to review, authorize, and monitor offshore aquaculture operations. The primary goal of the proposed aquaculture permitting program is to increase the maximum sustainable yield (MSY) and optimum yield (OY) of federal fisheries in the Gulf of Mexico by supplementing the harvest of wild caught species with cultured product.

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Fishery Impact Statement – Social Impact Analysis

This integrated document contains all elements of the Plan Amendment, DPEIS, Initial Regulatory Flexibility Analysis (IRFA), Regulatory Impact Review (RIR), and Social Impact Assessment (SIA)/Fishery Impact Statement (FIS). A table of contents for the SIA/FIS is provided separately to aid reviewers in referencing corresponding sections of the Amendment.

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Introduction

Mandates to conduct SIA come from both the National Environmental Policy Act (NEPA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). NEPA requires federal agencies to consider the interactions of natural and human environments by using a "...systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences...in planning and decision-making" [NEPA section 102 (2) (a)]. Under the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of the NEPA, a clarification of the terms "human environment" expanded the interpretation to include the relationship of people with their natural and physical environment (40 CFR 1508.14). Moreover, agencies need to address the aesthetic, historic, cultural, economic, social, or health effects which may be direct, indirect or cumulative (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment, 1994).

Recent amendments to the MSFCMA require FMPs address the impacts of any management measures on the participants in the affected fishery and those participants in other fisheries that may be affected directly or indirectly through the inclusion of a fishery impact statement [MSFCMA section 303(a)(9)]. National Standard 8 requires FMPs consider the impacts upon fishing communities to the extent practicable to assure their sustained participation and minimize adverse economic impacts upon those communities [MSFCMA section 301(a)(8)]. Consideration of social impacts is a growing concern as fisheries experience increased participation and/or declines in stocks. With an increasing need for management action, the consequences of such changes need to be examined to minimize the negative impacts experienced by the populations concerned to the extent practicable.

Data Limitations and Methods

Social impacts are generally the consequences to human populations that follow from some type of public or private action. Those consequences may include alterations to "...the ways in which people live, work or play, relate to one another, organize to meet their needs and generally cope as members of a society..." (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment, 1994). In addition, included under this interpretation are cultural impacts that may involve changes in values and beliefs, which affect the way people identify themselves within their occupation, communities and society in general. Social impacts analyses help determine the consequences of policy action in advance by comparing the status quo with the projected impacts. Therefore, it is important that as much information as possible concerning a fishery and its participants be gathered for an assessment.

It is important to identify any foreseeable adverse effects on the human environment. With quantitative data often lacking, qualitative data can be used to provide a rough estimate of some of the impacts based on the best available science. In addition, when there is a body of empirical findings available from the social science literature, it needs to be summarized and referenced in the analyses.

In attempting to assess the social impacts of the proposed amendment, it must be noted that there is an overall lack of literature and data available regarding the social impacts of offshore aquaculture in the Gulf of Mexico. The lack of data makes it difficult for this analysis to provide a comprehensive overview of the social impacts that could result from developing new offshore aquaculture permits; therefore, this analysis cannot predict all social impacts. To better understand the social impacts that result from this action, baseline information on each Gulf Coast fishing community would be required before the action is implemented. That information could then be compared to similar types of data collected from those communities after the aquaculture industry has had time to develop. Collecting those types of detailed baseline data require social scientists to spend adequate time in each community to collect the necessary information that would provide more insight into the impacts the proposed regulations have on communities and their residents.

Aquaculture firms that could develop under this amendment simply do not currently exist. Therefore, there is no information to assess whether Gulf coastal communities will benefit or be harmed by their existence. Information that is available pertains primarily to the commercial harvesting sector and imports from outside the Gulf of Mexico region. The available commercial data are records of landing reports and permit data. Those data provide general background information to use as a starting point for analysis of the impacts on commercial harvesters and their communities. The commercial fisheries, and their participants, that are most likely to be impacted by this action are discussed in Sections 5.3 and Section 7. However, there is not enough data on communities that may be dependent on these fisheries to fully describe the impacts aquaculture production will have on any one community. It is unrealistic to make these projections of impacts at the community level until aquaculture firms are created and there is information on their locations. The social impacts on non-commercial harvesters, the processing sector, the consumer, fishing communities, and society as a whole are not as thoroughly addressed

as would be if more information were available. The fishery impact statement consists of the description of the commercial fishery and the social impacts associated with the proposed actions. Data to define or determine impacts upon fishing communities are still very limited. However, these impacts have been analyzed and based on available fishery data.

E.O. 12898: Environmental Justice. Federal agencies are required to conduct their programs, policies, and activities in a manner to ensure individuals or populations are not excluded from participation in, or denied the benefits of, or subjected to discrimination because of their race, color, national origin, or income level. In addition, and specifically with respect to subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence.

Section 5.3.3 describes five fishing communities along the Gulf of Mexico coast. These communities were identified as key communities involved in the fishing industry based on fishing permit and employment data. The demographic information reported for these communities were derived from census data. Census data describes community-wide demographics and cannot be partitioned into just those populations that rely on federally managed Gulf fisheries. A key reason for this is the census data combines fishing occupations with farming and forestry occupations under the occupation category, and with agriculture, forestry, and hunting under the industry category. For this reason, demographic information on fishing communities is not available for use in evaluating the effects of the proposed actions on low-income and minority populations. Nevertheless, although demographics of these fishing communities are unknown, these actions would apply to all participants in the fishery, regardless of their race, color, national origin, or income level and, as a result are not considered discriminatory. The current demographic make-up of the respective fishing communities is assumed to be the result of historic cultural and economic conditions and not the result of specific historic or current management action that favored or discriminated against minority or low-income participants. Therefore, no environmental justice issues are anticipated and no modifications to any proposed actions have been made to address environmental justice issues. Additionally, none of the proposed actions are expected to affect any existing subsistence consumption patterns or raise any issues thereof.

Summary of Social Impact Assessment

When considering the social impacts of the proposed amendment it is important to realize that the objective of the amendment is to develop a permitting structure that would allow persons to grow and harvest species raised from the Gulf of Mexico EEZ. Current NOAA Fisheries Service permitting regulations, which require an exempted fishing permit to conduct offshore aquaculture, have impeded the development of domestic aquaculture in the EEZ. Therefore, implementation of this amendment is expected to provide a workable framework for aquaculture to develop.

Because implementation of the amendment would allow persons to apply for a permit, the number of applicants and the impacts are difficult to estimate. It is expected that under the status quo the supply of seafood will come from harvest by Gulf of Mexico commercial fishermen or close substitutes through imports. Those imports could be from wild stocks, but more likely would come from foreign aquaculture. The increased supply of aquaculture fish from the Gulf may tend to decrease the ex-vessel price commercial harvesters receive for their catch if the increased supply does not come on the market slowly, or if new markets for products are not created, or if the demand for seafood does not increase. If the TACs of affected species are stable, the commercial harvesters will earn lower revenues. Less revenue will mean that they have less income to spend in communities where they live or purchase supplies, which would negatively affect commercial harvesters, crew, support industries, and local tax bases.

Competition in a global market place will not go away if domestic aquaculture production is increased. With over 80 percent of U.S. seafood imported, increases in U.S. domestic aquaculture production in the Gulf EEZ are not likely to significantly affect prices unless a large volume of supply comes on line at once. The major competition is imports and other sources of protein (chicken, pork, beef). The challenge for U.S. fishermen is to use aquaculture as another technology to produce seafood.

Development of domestic aquaculture could generate additional supplies of fish in markets or simply displace foreign imports. If foreign imports are displaced, the commercial harvesters and their communities of residence and operation will be no worse off (revenues will be unchanged), and the communities that develop or support the aquaculture industry will be better off economically. If additional supplies of fish are in the U.S. market, then commercial ex-vessel prices could be reduced further. However, the economic activity from aquaculture may potentially generate greater community economic benefits than those lost through reduced commercial prices. The exact magnitude of the impacts cannot be projected until the industry is developed and additional research is conducted on the social impacts. However, a report by Kona Blue Water Farms (2003) indicated that about 25 percent of their recurring costs would be spent on labor and management with six full-time positions being created. Similar impacts could be expected for a similar-sized firm that begins operating in the Gulf[1].

Offshore aquaculture using submerged nets or pens for finfish or other techniques for shellfish would be more aesthetically pleasing than nearshore operations. It is expected that people in the communities adjacent to the aquaculture facilities will not see the facilities. Boaters may see markers required for each facility, but to reduce the impacts of weather, the pens and cages will be submerged with limited visibility from passing vessels.

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1 Posadas (2003) estimated the recurring costs would be about $1.3 million annually for a similarly sized facility in the Gulf of Mexico.

The social impacts of the program in general were discussed above. To the extent possible, the social impacts of the eight specific actions being considered in this amendment are summarized below. In some cases the social impacts from a specific alternative are limited.

Action 1: Types of Aquaculture Permits Required. **Alternative 1** would require aquaculture firms operate under an exempted fishing permit (EFP), but no firms have been successfully developed under that structure to date. The expected result is that the offshore aquaculture industry would not develop in the Gulf of Mexico. Commercial fishers and their communities would compete with imports to maintain their market prices and shares; however, imports would be expected to erode both. **Preferred Alternatives 2** and **Alternative 3** would establish aquaculture permits. **Preferred Alternative 2** would require only an operational permit, while **Alternative 3** would require both an operational permit and a siting permit. Under those permits the aquaculture industry is more likely to develop. The increased supply of fish could negatively impact commercial harvesters if the species grown directly compete with their catch or could positively benefit commercial harvesters if they participate in aquaculture activities. Depending on where aquaculture firms operate, fishing communities could also benefit. Seafood processors, consumers of seafood products, restaurants, and support industries in the local communities would also benefit from a stable, fresh supply of quality seafood.

Action 2: Duration of the Permit. The duration of the permit is expected to affect the amount of capital invested in aquaculture firms and the species that are raised**.** **Alternative 1** would retain the EFP structure that would issue permits for one-year with the possible renewal of the permit. This time frame is too short to provide time to recover fixed and variable investment costs. Aquaculture firms would have difficulty in finding investors. The lack of investment would limit the growth of the industry. Fewer jobs would be created in the aquaculture industry and support industries would not realize increased sales. **Alternatives 2(a-d)** would issue permits ranging from 5 years to an indefinite period. The longer the permit duration the more likely firms are to obtain investments and produce slower growing species. **Preferred Alternative 2(b)** is a 10-year permit, which some persons have indicated is the minimum permit duration necessary to attract investment at reasonable rates of return.

Action 3: Permit Conditions. Permit conditions generally fall into two categories: (a) an assurance bond to guarantee removal of structures when the permit expires and (b) information potential investors would need to provide to NOAA Fisheries Service prior to receiving a permit**.** **Alternative 1** would not specify any permit conditions. If insufficient information is collected, the public and government will not have enough information to make an informed decision regarding the impacts of a proposed facility. **Alternative 1** would also reduce environmental safeguards. **Preferred Alternative 2** would require an assurance bond, a use-it or lose-it provision, permit requirements to improve enforcement, various operational plans to manage genetic diversity and aquatic animal health, requirements for conducting environmental monitoring, requirements for

spawning and rearing broodstock, and other applicable permit conditions. Under **Alternative 1**, NOAA Fisheries Service would likely require sufficient information to manage the industry, but EFPs are not designed for long-term permitting. **Alternative 3(a)** would require an assurance bond to ensure removal of aquaculture structures when an operation terminates. This would require the firm to internalize the removal costs and reduce the chance that the public would need to fund removal. **Alternative 3(b)** would require the firms to submit information regarding brood fish for fingerling production, an aquatic health management plan, a plan for collecting and spawning broodstock and rearing fingerlings, and environmental monitoring. These are standard provisions of aquaculture regulations in many U.S. states and in other countries and are likely to be areas of concern to the general public. Collecting and reporting this information on regular intervals will help inform the public of the impacts aquaculture has on the ecosystem. **Alternative 3(c)** would provide law enforcement the tools needed to help prevent poaching and the sale of illegal wild caught fish mixed in with cultured product. These tools help ensure the mission of protecting and conserving the resources of the Gulf can be accomplished by closing loopholes (e.g., size limits) that may be exploited through the creation of a regional aquaculture permitting program. **Alternative 3(d)** is intended to eliminate speculative entry. There has been some concern expressed about companies or individuals applying for permits merely to secure the "rights" to a given site and then attempting to sell or lease that site at a cost to an aquaculture company. This could be possible if a company or person were to identify the best areas for aquaculture facilities to be sited and then secure permits for those sites with no intent to conduct aquaculture operations at these sites. **Alternative 3(e)** would require other information to aid in enforcement and monitoring. **Alternative 3(f)** would provide the NOAA Fisheries Service Regional Administrator authority to establish other appropriate permit conditions necessary for issuance and administration of an aquaculture permit.

Action 4: Species Allowed for Aquaculture. Only **Alternative 1**, the no action alternative, would allow permit holders to raise non-indigenous species. If escapement were to occur, the costs and impacts on society may be high or may be negligible depending upon the species, ecosystem, whether or not the fish/shellfish is sterile, number of escapes, and other factors. **Alternative 2** would allow for the aquaculture of most species managed by the GMFMC and/or SAFMC. Four primary species – spiny lobster, stone crab, corals, and shrimp – would be excluded. **Alternative 3** is somewhat more flexible than **Alternative 2** in that it would also allow for EEZ aquaculture of spiny lobster and stone crab. However, it would preclude the aquaculture of shrimp, corals, and goliath and Nassau grouper. **Alternative 4** would allow the aquaculture of all marine species managed by the Council native to the Gulf of Mexico, except shrimp and corals, and would request NOAA Fisheries Service to include highly migratory species. The aquaculture of live rock would continue to be regulated through existing management measures approved in Amendments 2 and 3 to the Coral and Coral Reefs FMP. The more flexibility firms are given the more likely they are to develop a viable industry that would benefit local communities. Additionally, requiring aquaculture firms culture only species native to the Gulf of Mexico will provide additional safeguards and protection to domestic fisheries in the event of escape.

Action 5: Allowable Marine Aquaculture Systems. **Alternative 1** does not specify allowable marine aquaculture systems. **Alternatives 2** would allow cages and nets and **Alternative 3** would allow cages, net pens, and other aquaculture systems for invertebrate species. Preferred Alternative 4 would provide NOAA Fisheries Service authority to review aquaculture grow-out systems on a case-by-case basis to ensure reliable offshore growing system technology is used. Benefits to society under **Alternatives 1, 3,** or **4** are expected to exceed those under **Alternative 2,** because they allow for a greater number of potential systems in which to conduct aquaculture and therefore would provide aquaculture firms with greater diversity of systems to culture the wide array of native Gulf species. The systems used will all need to be able to withstand weather conditions that exist in the Gulf of Mexico.

Action 6: Designation of Sites or Areas for Aquaculture. The status quo, **Alternative 1**, would not designate areas in the Gulf EEZ where aquaculture would be allowed. **Alternative 2** would establish marine aquaculture areas that are pre-permitted. Aquaculture operations would not be limited to these marine aquaculture areas. **Alternative 3** does not establish marine aquaculture areas, but would establish criteria for siting marine aquaculture facilities that must consider public and private needs. The criteria included in the siting process may be more critical for public acceptance than specifying specific areas that may or may not be sites actually used. **Preferred Alternative 4** would establish criteria for siting marine aquaculture facilities, including the requirements of other federal agencies. Those criteria would be reviewed on a case-by-case basis by NOAA Fisheries Service in determining the appropriateness of a facility's siting.

Action 7: **Establish Buffer Zones for Marine Aquaculture Facilities**. If created, marine buffer zones would limit access to areas around aquaculture facilities. **Preferred Alternative 1** would not restrict access around an aquaculture facility**. Alternative 2** would create buffer zones for marine aquaculture facilities that would prohibit fishing and fishing vessels from entering the area. Restricting access around marine aquaculture facilities to that needed to provide protection for the firm would minimize impacts to other users of the area. If the permit sites (Action 6) provide sufficient protections for the aquaculture firms, setting aside additional space for a buffer zone would not be needed or create any additional benefits for the aquaculture firm. However, it may be more prudent to defer to the USCG as they have authority to establish safety zones in the navigable waterways of the United Sates EEZ. Additionally, buffer zones may be perceived by many fishermen as a form of marine protected area that limits where they can fish. If buffer zones are established, it will be important to site aquaculture facilities in areas where there are not important fishing grounds and where user conflicts would be low.

Action 8: Recordkeeping and Reporting. This action would define specific pieces of information that would be required from aquaculture firms. Under **Alternative 1** the Regional Administrator has authority to specify recordkeeping and reporting requirements in an EFP. Members of the public would rely on NOAA Fisheries Service to protect their interests without specific direction beyond that included in the EFP requirements. **Alternative 2** would establish specific reporting requirements that must be

met to obtain and keep aquaculture permits. That information will help keep regulatory agencies informed and allow them to make decisions regarding the impacts of aquaculture facilities. Information would include: submitting an annual report to NOAA Fisheries Service, copies of permits from other federal agencies, reports of disease, escapement, and entanglement, and numerous other recordkeeping and reporting requirements. Some organizations and people are concerned that aquaculture firms are using a public resource to operate their businesses, and that those businesses could impact the wild stocks of fish in the Gulf. This action would allow NOAA Fisheries Service be informed of activities that occur at marine aquaculture facilities that could impact the overall health of the ecosystem.

1.0 Executive Summary

Demand for protein is increasing in the United States; nearly 75 percent of all seafood consumed is currently imported from other countries. As demand grows, commercial wild-capture fisheries will not likely be adequate to meet this growing demand. Aquaculture is one method to meet current and future demands for seafood.

The Gulf of Mexico Fishery Management Council has authority to regulate fisheries in federal waters, including aquaculture. Currently, NOAA Fisheries Service requires an exempted fishing permit (EFP) to conduct aquaculture in federal waters. This permit is of limited duration and is not intended for commercial production of fish, making aquaculture in federal waters not viable under the current permitting process.

The purpose of this FMP amendment is to develop a regional permitting process for regulating and promoting environmentally sound and economically sustainable aquaculture in the Gulf EEZ. Establishing such a process requires the Council to develop a generic amendment to their FMPs. This amendment, including the Programmatic Environmental Impact Statement (PEIS), would serve as the basis for evaluating the effects of issuing a permit for Gulf of Mexico aquaculture operations. Project specific effects would be further analyzed through additional National Environmental Policy Act analyses if they fall outside the scope of the actions proposed herein.

This amendment considers eight actions, each with an associated range of management alternatives, for establishing a regional permitting process. The full range of alternatives considered in this amendment is described in Section 4.0. A detailed discussion of the environmental consequences associated with each action and alternative is provided in Section 6. The proposed measures and actions in this amendment are all intended to assist the Council and NOAA Fisheries Service in achieving the purpose of this amendment, which is to maximize benefits to the Nation by establishing a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico. By establishing a regional permitting process for aquaculture, the Council will be positioned to achieve there primary goal of increasing maximum sustainable yield (MSY) and optimum yield (OY) of federal fisheries in the Gulf of Mexico by supplementing harvest of wild caught species with cultured product.

A short summary of each action is provided below.

Major Conclusions

Action 1: Types of Aquaculture Permits Required – This action considers establishing a permit for conducting aquaculture in federal waters of the Gulf of Mexico. The Council's preferred alternative (**Preferred Alternative 2**) would require a NOAA Fisheries Service permit to operate a marine aquaculture facility in the Gulf of Mexico EEZ. Other alternatives considered by the Council included maintaining the requirement for an EFP (**Alternative 1**) or requiring separate NOAA Fisheries Service operational

and siting permits (**Alternative 3**). Aquaculture under the current EFP process is not viable, while requiring a separate siting permit would be partially duplicative of other federal permitting requirements already in place (e.g., Army Corps of Engineers siting permits). **Preferred Alternative 2** would still provide NOAA Fisheries Service authority to evaluate various siting criteria when deciding whether or not to issue an operational permit. Proposed criteria are summarized in Action 6 (Designation of Sites or Areas for Aquaculture). In order to receive and maintain such a permit, conditions proposed in Actions 3 (Permit Conditions) and 8 (Recordkeeping and Reporting) would also have to be met. **Alternative 1** would restrict the development of offshore aquaculture in the Gulf and therefore would result in no impacts to the physical, biological, and ecological environments unless an aquaculture facility was able to successfully develop an operation under the current EFP permitting process. **Preferred Alternatives 2** and **Alternative 3** would create a regulatory permitting process and therefore would indirectly effect the physical, biological, and ecological environments by allowing the potential development of an aquaculture industry. Impacts to the physical and biological environments would depend on numerous factors, including where a facility is sited, the potential for fish escapement, the types of species allowed for aquaculture, the business practices of an operation, etc. Preferred alternatives selected in other Actions within this amendment are intended to mitigate or prevent impacts to wild Gulf resources resulting from the permitting of marine aquaculture operations. Such measures include extensive permit conditions and recordkeeping requirements (Actions 3 and 8), a requirement to use only native, non-transgenic species for culture (Action 4), case-by-case review of allowable marine aquaculture systems (Action 5), and siting criteria (Action 6).

Action 2: Permit Duration – This action proposes permit durations ranging from one year (EFP permit) (**Alternative 1**) to indefinitely (**Alternative 2(d)**). The Council's preferred alternative (**Preferred Alternative 2(b)**) would allow permits to be effective for 10 years, with renewals every five years thereafter. Ten years is considered by many to be the minimum permit duration necessary to attract financial investment at reasonable rates of return. The duration of permit issuance will not have any direct effects on the physical, biological, or ecological environments, but will indirectly effects these environments. Permit duration is of primary importance for business planning purposes and not for monitoring effects on the various environments. Regardless of the length of the permit, NOAA Fisheries Service would regularly review operations for compliance with governing regulations (see Actions 3 and 8). This will ensure operations are operating properly and not causing unacceptable impacts to the biological or ecological environments.

Action 3: Permit Conditions – This action proposes conditions aquaculture operations would have to meet for an operational permit (Action 1). The Council's preferred alternative (**Preferred Alternative 3**) would require aquaculture operations obtain an assurance bond, describe plans for maintaining genetic diversity, rearing and spawning broodstock, environmental monitoring, and aquatic animal health. The preferred alternative also includes requirements to enhance enforcement capabilities, a "use it or lose it" provision, and numerous other permit conditions . All of these conditions would

have to be met to issue and/or maintain an operational permit. The assurance bond would require an operation remove structures associated with the operation as a condition of the permit, thereby diminishing long-term impacts that could result from structures remaining in the environment. The required management plans will provide NOAA Fisheries Service with critical information before issuance of a permit. These plans will allow for review of an aquaculture operations business practices to ensure they are environmentally sound and appropriate to prevent, to the extent practicable, impacts on the environment and wild stocks. The "use it or lose it" provision would require permit holders to begin operation of a facility within two years of permit issuance. This will discourage speculative entry. The final requirements of the preferred alternative require other information to aid in enforcement, monitoring, and permit administration The Council also considered not specifying permit conditions (**Alternative 1**) and requiring conditions based on current EFP regulations (**Alternative 2**). **Preferred Alternative 3** would result in the greatest benefits to the biological and physical environments by providing necessary safeguards for environmentally sustainable aquaculture. These safeguards would assist the Council and NOAA Fisheries Service in preventing, or minimizing to the extent practicable, impacts on water quality, benthic habitat, and wild fish stocks. **Preferred Alternative 3** results in the greatest economic and administrative costs of any of the alternatives considered, but these costs are more than offset by the benefits to the biological, physical, and social environments.

Action 4: Species Allowed for Aquaculture – This action considers species that would be allowed for aquaculture. The Council's preferred alternative (**Preferred Alternative 4**) would allow the aquaculture of all Council managed species, except corals and shrimp. Only native, non-transgenic species would be allowed for culture. The Council would also request NOAA Fisheries Service develop concurrent rulemaking to allow aquaculture of highly migratory species. There is some evidence of the detrimental effects of non-native species on ecosystems. By allowing only native, non-transgenic species for culture, the potential for negative impacts on the biological, physical, and ecological environments will be eliminated or significantly reduced. Other alternatives considered by the Council included not specifying species for aquaculture (**Alternative 1**), only allowing Council managed finfish to be cultured (**Alternative 2**), and allowing all species managed by the Council, except shrimp, corals, and goliath and Nassau grouper (**Alternative 3**). Under **Preferred Alternative 4**, the culture of live rock would continue to be regulated by management measures approved in Amendments 2 and 3 to the Coral and Coral Reef FMPs.

Action 5: Allowable Marine Aquaculture Systems – This action specifies the types of aquaculture systems that would be allowed for culture. The Council's preferred alternative (**Preferred Alternative 4**) would provide NOAA Fisheries Service authority to evaluate each proposed aquaculture system on a case-by-case basis. Other alternatives considered include: not specifying allowable systems (**Alternative 1**), allowing only cages and net pens (**Alternative 2**), and allowing cages, net pens, and other systems for the culture of various invertebrates (**Alternative 3**). Unlike **Alternatives 2** and **3**, **Preferred Alterantive 4** would allow for novel new aquaculture systems to be used as they are developed and provide aquaculture operations with the greatest amount of

flexibility when selecting systems for culture of a wide-array of species. For these reasons, **Preferred Alternative 4** would provide the greatest benefits to the physical, biological, social, and economic environments. However, because aquaculture grow-out systems would be reviewed on a case-by-case basis, the preferred alternative would also provide for a greater burden on NOAA Fisheries Service staff.

Action 6: Designation of Sites or Areas for Aquaculture – This action proposes designating sites or areas for marine aquaculture. Proper siting of an aquaculture facility is critical to both an operation's success and the protection of the surrounding physical, biological, and ecological environments. If a facility is not properly sited, there is potential for significant environmental impacts to occur. These could range from habitat degradation of surrounding benthos to changes in water quality (e.g., low dissolved oxygen or increased nutrients). To prevent impacts to the biological and physical environments, Action 6 proposes either developing siting criteria for facilities (**Alternative 3** and **Preferred Alternative 4**) or developing pre-authorized areas for marine aquaculture (**Alternative 2**). The Council also considered not specifying criteria or designating areas where aquaculture may occur (**Alternative 1**). The Council's preferred alternative (**Preferred Alternative 4**) would not establish specific areas for marine aquaculture, but would establish general siting criteria to be applied on a case-by-case basis. This would allow NOAA Fisheries Service to determine siting locations that minimize or eliminate the potential for environmental impacts. The benefits to the biological and physical environments are expected to be greater than **Alternative 1** and similar to **Alternatives 2** and **3**. **Preferred Alternative 4** and **Alternative 3** potentially provide aquaculture firms with the greatest flexibility and could yield the greatest Net National Benefits compared to **Alternative 1** or **Alternative 2**.

Action 7: Establish Buffer Zones for Marine Aquaculture Facilities – This action proposes establishing buffer zones around marine aquaculture facilities. The Council's preferred alternative (**Preferred Alternative 1**) would not restrict access around a marine aquaculture facility. **Alternative 2** would restrict access around a marine aquaculture facility. The Council does have authority to create zones that excludes fishing or fishing vessels. Creation of buffer zones for aquaculture facilities would potentially provide limited benefits to investors; particularly in terms of liability issues and protection of investment. Restricting access around a facility may directly affect the physical, biological, and ecological environment by protecting species known to aggregate around structure. Aquaculture facilities have been shown as aggregation sites for many wild species. Additionally, the lack of anchoring or any other interactions that may occur with the physical environment will benefit the benthos of these restricted sites. Also, preventing access around a facility will reduce the likelihood of damage to a facility, and particularly cages and net pens, thereby reducing any potential impacts associated with fish escapement. Overall, **Alternative 2** would provide greater benefits to the physical, biological, economic, and ecological environments when compared to **Preferred Alternative 1**. However, the social environment may be negatively effected if buffer zones are perceived as a form of marine protected area that limits where fishermen can catch fish

Action 8: Recordkeeping and Reporting – This action proposes recordkeeping and reporting requirements for aquaculture operations. As mentioned in the discussion for Action 1 above, these requirements would be part of the conditions for maintaining an operational aquaculture permit and would allow NOAA Fisheries Service to evaluate the impacts of a marine aquaculture operation. The Council's preferred alternative (**Preferred Alternative 2**) includes a myriad of recordkeeping and reporting requirements, such as providing NOAA Fisheries Service with relevant federal and state permits, reporting to NOAA Fisheries Service the harvesting and landings of cultured fish, and reporting incidents of disease, escapement, marine mammal and migratory bird entanglement. Several additional records and reports would also be required, including a standardized annual report to address all requirements listed in Action 8. The intent of these requirements is to minimize or prevent impacts to wild stocks, habitat, and other biological resources. The Council also considered another alternative (**Alternative 1**) that would allow the Regional Administrator to specify recordkeeping and reporting requirements as specified in EFP regulations. **Preferred Alternative 2** requires a more comprehensive list of recordkeeping and reporting requirements than **Alternative 1**, and therefore would benefit the physical and biological environments more. Record keeping and reporting is an administrative function and would directly affect the administrative environment. Applicants would incur costs associated with preparing reports and maintaining records and the burden on NOAA Fisheries Service would be increased to review records and reports for compliance with permit conditions. However, these costs are outweighed by the environmental safeguards afforded to the physical and biological environments.

Areas of Controversy

Development of a regulatory framework for aquaculture has been controversial. Controversy has stemmed from several factors including, but not limited to:

- Concerns about potential impacts to the environment (e.g., water quality, habitat degradation, etc.) and wild fish stocks (e.g., genetic modification, competition, entanglement, etc.) resulting from this action;
- Competing interests between fishermen, fishing communities, and aquaculture operations; and,
- The exclusive use of public resources for private profit.

Common concerns regarding marine aquaculture include impacts to water quality and essential fish habitat, fish escapement and disease, entanglement and attraction of wildlife, use of invasive species that may compete with wild stocks, loss of fishing grounds, and user conflicts due to the potential for increased competition. Section 6.1 discusses each of these potential impacts and environmental consequences in greater detail and Section 6.13 discusses several unavoidable adverse effects that may result from the proposed actions. The proposed actions and preferred alternatives in this amendment are intended to minimize, to the extent practicable, impacts to the physical, biological, social, and economic environments. Measures to mitigate the impacts mentioned above, which are often the major causes of controversy, are discussed in Section 6.11. These

include the exclusive use of non-genetically modified, native species from the Gulf of Mexico (Action 4) for aquaculture, extensive permitting, siting, and recordkeeping requirements (Actions 3, 6, and 8), and the use of reliable offshore aquaculture systems that would be approved on a case-by-case basis (Action 5).

2.0 Introduction

2.1 Background

Worldwide demand for protein is increasing and fisheries production will not be adequate to supply the needs of the world's population without supplementation through aquaculture (NMFS 1998). In the United States, nearly three-quarters of all seafood consumed is currently imported from other countries, creating a 7.8 billion dollar trade deficit (NOAA 2004). It is estimated by 2025, two million more metric tons of seafood will be needed over and above what is consumed today (NOAA 2004). Commercial wild-capture fisheries will not likely be adequate to meet this growing demand considering commercial fishery production has remained stable or declined in recent decades, due to overfishing and increasingly stringent management restrictions (Tidwell and Allan 2001; NOAA 2004).

Aquaculture is one method to meet current and future demands for seafood. NOAA's Aquaculture Policy defines marine aquaculture as the propagation and rearing of aquatic animals in controlled or selected aquatic environments for any commercial, recreational, or public purpose. Marine aquaculture is analogous to terrestrial farming and involves some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, and protection from predators. Marine aquaculture includes coastal and offshore aquaculture operations as well as saltwater pond and tank systems. Offshore aquaculture refers to marine aquaculture operations located in the exposed open ocean environment of the U.S. Exclusive Economic Zone (EEZ). Floating or submerged net-pens or cages are the most commonly used offshore aquaculture systems. Long-line or vertical-line arrays and artificial or natural hard-substrates may also be used for offshore aquaculture.

The Gulf of Mexico Fishery Management Council (Council) has authority to regulate fisheries in the U.S. EEZ, which extends from state territorial waters to 200 miles offshore. Based on a legal opinion by NOAA General Counsel (GC), landings or possession of fish in the EEZ from commercial marine aquaculture production of species managed under fishery management plans (FMPs) constitutes "fishing" as defined in the MSFCMA [See Sec. 3(16)]. Therefore, in order to allow commercial aquaculture production in the EEZ, the Council must amend FMPs to allow for such activity for managed species and for the regulation of the activity by NOAA Fisheries Service. Scientific activity for marine aquaculture in the EEZ is currently regulated by federal rule for an Exempted Fishing Permit under 50 CFR 600.745 (see Appendix A).

There has been increasing interest in conducting offshore aquaculture in the Gulf of Mexico in recent years. The NOAA Fisheries Service issued one EFP in 1997 for an

offshore aquaculture operation off of Texas and since that time has received three additional requests for EFPs. Additionally, the Sea Grant Gulf of Mexico Offshore Aquaculture Consortium (GOAC) was formed in 2000 to create a collaborative, Gulf-wide, university-based interdisciplinary research program to address social, environmental and technological issues associated with offshore aquaculture in the Gulf of Mexico. This program was later terminated because of a lack of federal funding. Most recently, the state of Louisiana created a Platform for Marine Aquaculture Task Force to assess the economic feasibility, environmental impact, and legal/regulatory considerations of utilizing offshore oil and gas platforms for culturing marine organisms in the Gulf.

Despite the growing interest in offshore aquaculture in the Gulf of Mexico, there is currently no regulatory framework to allow commercial aquaculture production in the EEZ. The existing regulatory process is complex and multiple permits must be obtained from several different federal agencies, including the EPA, ACOE and NOAA Fisheries Service, before a facility can begin operation. To date, all commercial finfish aquaculture facilities in the U.S. have been sited in state territorial waters, although a few research facilities have been sited in EEZ waters (Borgotti and Buck 2004).

Other impediments to the development of an aquaculture industry are numerous (Cicin-Sain et al. 2001) and include, but are not limited to:

1. potential environmental impacts associated with aquaculture
2. public opposition
3. user conflicts
4. economic risks from storm damage
5. availability of investment capital
6. competition from foreign markets

Aquaculture in general has received growing criticism due to past and potential environmental effects associated with aquaculture (Tiersch and Hargreaves 2002). Criticism stems from concerns about the escape of fish, the use of antibiotics, environmental impacts associated with excess feed and wastes, and the spread of disease (Goldburg and Triplett 1997; Naylor et al. 2000, 2001; Tidwell and Allan 2001; Borgotti and Buck 2004). Many of these concerns stem from practices in salmon, shrimp, catfish, and other forms of aquaculture that are no longer practiced in North America. For example, vaccination has replaced use of antibiotics, there is no evidence of the spread of disease from farmed fish to wild fish in the U.S., and proper siting and feed management has reduced or eliminated concern about wastes. However, open ocean offshore aquaculture may present advantages over that of inshore or terrestrial aquaculture. For example, offshore aquaculture facilities may allow for more efficient assimilation of wastes and feed in the open ocean environment (Borgotti and Buck 2004). Also, because facilities are located farther offshore, user conflicts may be diminished. Several research studies are currently underway in Hawaii, New Hampshire, California, and Puerto Rico to assess the environmental and economic impacts of open ocean aquaculture operations.

The Gulf of Mexico represents an opportune environment for the development of offshore aquaculture, with its broad continental shelf, numerous ports, and existing infrastructure of oil and gas platforms. Development and effective management of offshore aquaculture in the Gulf EEZ will require balancing the benefits of aquaculture (e.g., economic development, expanded protein supplies, and environmental benefits) with environmental and social concerns (DeVoe and Hodges 2002). Responsible marine aquaculture will require sound management, environmental safeguards, and continued research and technological development (Stickney and McVey 2002).

2.2 Management History

National Aquaculture Policy

In 1980, the National Aquaculture Act (NAA) was passed, which established a national aquaculture policy. The NAA "declares that aquaculture has the potential for augmenting existing commercial and recreational fisheries and for producing other renewable resources, thereby assisting the U.S. in meeting its future food needs and contributing to the solution of world resource problems. It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States."

The NAA required the Secretaries of Commerce, Interior, and Agriculture to prepare a National Aquaculture Development Plan (NADP) within 18 months of enactment. The NADP was to identify potential species for commercial aquaculture development, and to discuss public and private actions and research necessary to carry out the objectives of the Act. The Act also called for creation of the Joint Subcommittee on Aquaculture (JSA) in the Federal Coordinating Council on Science, Engineering, and Technology (Coordinating Council). The JSA's responsibility was to increase the productivity of federal aquaculture research, technology transfer, and economic assistance programs through study and assessment, coordination, planning, collection, and dissemination of information, and provision of advice to the Coordinating Council.

The NAA provided an important statement of policy; however, it did not address continuing federal, state, and local barriers to domestic aquaculture. Those barriers were recognized in the NADP of 1984; however, because the administration's policy was that the primary responsibility for the development of commercial aquaculture rested with the private sector, there were no recommendations to increase federal funding.

In 1985, the NAA was reauthorized and renamed The National Aquaculture Improvement Act (NAIA). The NAIA enacted two major amendments. First, the U.S. Department of Agriculture (USDA) was designated as the lead federal agency with respect to the coordination and dissemination of national aquaculture information. Second, two new studies were commissioned to be reported to Congress. The Secretary of Commerce was required to study and report to Congress whether existing capture fisheries could be adversely affected by competition from commercial aquaculture enterprises; and the Secretary of the Interior was required to study and report to Congress the extent and

impacts of the introduction of exotic species into U.S. waters as a result of aquaculture activities.

In April 1988, Commerce's study was completed and presented in the report, Aquaculture and Capture Fisheries: Impacts in U.S. Seafood Markets. The report focused exclusively on the effects of farm raised shrimp and salmon on capture shrimp and salmon fisheries. The report considered potential effects of increased supplies of domestically cultured shrimp and salmon on domestic prices of the two products; however, it did not consider potential adverse impacts of lower domestic market prices on long-run revenues and/or profits of salmon and shrimp fishermen and structural changes in the domestic industries that result from increased domestic aquaculture production.

One of the report's findings was that while domestic demand for shrimp would continue to grow, domestic production of wild shrimp was at its biological limit and domestic cultured shrimp production was limited. Another finding was that while domestic and foreign demand for salmon would continue to grow through the 1990s, U.S. salmon fishermen and salmon farmers were at a competitive disadvantage because both foreign imports of cultured salmon entered the U.S. duty free and U.S. seafood export opportunities were hindered by foreign trade barriers. Thus, it was predicted that foreign producers of cultured shrimp would have an increasing share of the domestic market.
On June 8, 2005, Senators Stevens and Inouye introduced a bill (S. 1195), hereby cited as the National Offshore Aquaculture Act of 2005, to provide the necessary authority to the Secretary of Commerce (Secretary) for the establishment and implementation of a regulatory system for offshore aquaculture in the U.S. EEZ, and for other purposes. The draft bill was revised and reintroduced in 2007 by Congressman Rahall as the National Offshore Aquaculture Act of 2007 (Appendix B). Specifically, the bill would authorize the Secretary to establish a process to make areas of the EEZ available to eligible persons for the development and operation of offshore aquaculture facilities, which would include:

- a permitting process;
- 20-year permits for offshore aquaculture, renewable in increments up to 20 years and transferable
- Department of Interior (DOI) concurrence for aquaculture located on leases or authorized easements or for which a permit has been issued under the Outer Continental Shelf Lands Act (OCSLA) or within 1 miles of any other facility for which a permit has been issued under the OCSLA;
- Clear environmental requirements and safeguards for the marine environment and wild stocks
- Requirement to conduct an environmental assessment of offshore aquaculture
- Requirements to consult with other federal agencies, states, fisheries management councils, and the public
- Criminal and civil penalties for permit violations
- Anyone is eligible to apply for permits, but non-U.S. residents or companies must have a U.S. agent.
- All existing laws and regulations still apply

- Exemption from the MSFCMA definition of fishing, but not from other provisions of MSFCMA
- Ability for states to "opt out."

Currently, the only legal avenue for EEZ finfish aquaculture is under an EFP, as provided at 50 CFR 600.745. However, an EFP is intended to authorize the targeting or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited. Specifically, an EFP authorizes activities for limited testing, public display, data collection, exploration, health and safety, environmental cleanup, and/or hazard removal purposes.

NOAA Fisheries Service also has authority under the Fish and Wildlife Coordination Act, the Essential Fish Habitat Provisions of the MSFCMA, the Endangered Species Act, and the Marine Mammal Protection Act to comment on any project under review by the Army Corps of Engineers or other agency, such as aquaculture, if there is federal involvement in the project (i.e., permitting, licensing, funding, etc.).

Gulf of Mexico Fishery Management Council's Aquaculture Policy

In November 2003, the Gulf Council adopted an open ocean aquaculture policy for the Gulf of Mexico EEZ (Appendix C). The policy consists of a variety of guidelines intended to encourage environmentally responsible aquaculture. The Council provided recommendations for six key areas: 1) allowable species, 2) habitat protection, 3) research, 4) location and design, 5) water quality, and 6) health management and disease control. These key areas were considered during the development of this amendment and the Council's recommendations are consistent with the proposed actions and preferred alternatives in this amendment.

Federal Regulatory Management in the Gulf of Mexico

The history of federal regulatory management of aquaculture in the Gulf of Mexico is brief. In 1994 and 1995, the Gulf and South Atlantic Fishery Management Councils developed and NOAA Fisheries Service implemented a regulatory regime for the culture of live rock (GMFMC 1994, 1995). Wild live rock is coral-reef rubble that has been populated by attached organisms including anemones, sponges, tubeworms, sea squirts, bryozoans, algae, etc., as well as by mobile organisms. Because "wild" live rock is habitat and harvest reached levels exceeding 500,000 pounds annually in the early 1990s, NOAA Fisheries Service phased out harvest of wild live rock and required persons in the industry to shift to aquaculture of live rock. Aquaculture of live rock consists of placing substrate, such as calcareous rock geologically or otherwise distinguishable from naturally occurring substrate, on permitted bottom sites for several years until attached organisms populate it. Site selection is regulated by certain criteria, as are the operations, including notifying enforcement agents when harvesting or placing of substrate are to occur (see GMFMC 1994, 1995 for details of these criteria). The state or ACOE requires permits for a site. An aquaculture permit and reporting of landings are required by NOAA Fisheries Service. In 2007, there were 35 live rock operations permitted in the

southeast. This amendment would not modify existing regulations pertaining to live rock aquaculture.

Currently Operating and Proposed Offshore Aquaculture Facilities in the U.S.

Currently Operating

At present, there are only five operating offshore finfish farms in the U.S.; however, none of them operate in federal waters and, therefore, do not have an EFP. Furthermore, none of these farms operate in the Gulf of Mexico. These offshore finfish farms are: 1) Cates International Inc. (now called Hukilau Foods), which grows Pacific threadfin, also known as moi, in Hawaiian waters; 2) Kona Blue Water Farms, which grows amberjack, also known as kampachi or kahala, in Hawaiian waters; 3) Snapperfarm, Inc., which raises cobia and mutton snapper off the coast of Culebra, Puerto Rico; 4) the University of New Hampshire Open Ocean Aquaculture demonstration project that raises halibut, haddock, summer flounder, and cod in New Hampshire waters; and 5) Isle of Shoals Mussels, a commercial longline mussel operation started by commercial fishermen in New Hampshire.

Cates International Inc. (Cates; aka Hukilau Foods) was formed in 1999 "to pursue commercial open ocean aquaculture in State marine waters (HDLNR and DA 2006)." In April 2000, the company submitted all Federal, state, and county permit applications for a four-cage project using 28 acres of ocean two miles off Ewa Beach, Oahu (HDLNR and DA 2006). On March 9, 2001, the State Board of Land and Natural Resources authorized a 15-year ocean leasing agreement between the State and Cates for the commercial production of fish in offshore sea cages (Hawaii Dept. of Agriculture 2001). The company signed the actual lease document in August 2002 and became the first in U.S. history to obtain an ocean lease for aquaculture (HDLNR and DA 2003). In 2003, the company posted sales of moi of $1.4 million, all of which was invested back into the company (Hedlund 2005). The following year the company's production of moi climbed from 6,000 pounds a week to 7,000 to 10,000 pounds a week (Hedlund 2005; Hawaii DLNR and DA 2004). In 2006, production was inconsistent due to difficulties with hatchery production of enough fingerlings to stock the cages (HDLNR and DA 2007).

The company buys its fingerlings from the Oceanic Institute, which is a research institution not driven by sales of fingerlings. Another problem is the location of Cates' hatchery, which is on the opposite end of Oahu, which means it must truck its fingerlings across the island. In August 2005, Gima (2005) reported that the harvest had dropped to "as little as 1,200 pounds of moi" due to several factors: First, the Oceanic Institute was unable to produce enough fingerlings; second, Cates' main harvest boat had been in dry dock for maintenance; and third, the company was growing the fish to a larger size. However, Cates has invested in its hatchery in order to increase its production to about 4 million fry per year, which translates into 2.5 million to 3 million pounds of moi (Gima 2005).

Additionally, Cate's has secured a lease for a site on the leeward coast of Oahu to build a large scale moi hatchery (HDLNR and DA 2006). Construction was expected to be completed in early 2007 (HDLNR and DA 2006).

Kona Blue Water Farms (Kona) is a wholly owned subsidiary of Black Pearls Inc., the latter which consults and develops commercial pearl farms around the globe. Kona was formed in 2001. Since August 2002, it has been selling 500 to 1,000 pounds of tank-raised fish each week to local restaurants for sashimi, and also fillets to Pacific Rim countries (Command 2005). In 2003, it received approval to lease 81 acres in Hawaiian waters 150 to 200 feet deep to raise mahi mahi and other fish in eight cages (Gonser 2003). In 2005, Kona completed installation of the moorings and first pair of submersible grow-out cages, and stocked them with 30,000 juvenile Kona kampachi (Associated Press - April 7, 2005). In 2007, a total of eight submersible cages (SeaStation™) in a grid type mooring system had been deployed. The company reported a total investment of $33 million dollars to date and as of 2006 employed 33 people (HDLNR and DA 2006). Because of high demand for their product, the company planned to look for a multi-million dollar site to expand in 2007 (HDLNR and DA 2006).

Snapperfarm, Inc. raises primarily cobia in submerged cages 35 feet below the ocean surface off the coast of Culebra, Puerto Rico. Two submerged (SeaStation™ – capacity 3,000 m^3) cages were first installed in 2002. In 2003, the company produced 50,000 pounds of fish, mostly cobia (Hedlund 2005). A big challenge for the company has been acquiring fingerlings. Currently, the company buys fingerlings from the Aquaculture Center of the Florida Keys and the University of Miami, and transporting them to its site takes 30 hours and is expensive (Hedlund 2005). Snapperfarm is currently conducting research on the feasibility of culturing Caribbean spiny lobster (http://www.snapperfarm.com/). Current production is also limited to 50 tons, but the company would like to increase production to 750 tons (http://www.snapperfarm.com/content/articles/Caribbean%20Business%20January%202007.pdf).

The University of New Hampshire (UNH) Open Ocean Aquaculture (OOA) demonstration project began in 1997. The goal of the project is to provide the research and development necessary to stimulate an environmentally sustainable offshore aquaculture industry in New England and nationwide. It raises fish in a 30-acre site in New Hampshire state waters approximately one mile south of White Island and six miles from the mainland. The project began to raise fish in offshore cages in 1999. Currently, the project operates three cages at the site (two SeaStation™ SS600's and one SeaStation™ SS3200). UNH's OOA project has grown summer founder, halibut, cod, and haddock (UNH 2007). The project has also successfully developed methods for culturing blue mussels on longlines. This technology has already been transferred to local fishermen, resulting in the first offshore mussel farm (Isles of Shoals) in the United States (http://ooa.unh.edu/news/releases/2007-10_gregg/mussels_release.html). Currently, Isle of Shoals can produce 180,000 pounds of mussels annually.

Currently or Previously Applying for Permits outside the Gulf

Three other Hawaiian companies are in the process or have previously applied to operate finfish farms in Hawaiian waters and one company is applying for permits to operate a finfish farm in Puerto Rican waters. These companies are the Ahi Nui Tuna Farming Company (Ahi Nui), Ahi Farms Inc. (Ahi Farms, also known as Ahi Aquaculture Farms), Pacific Ocean Ventures, and Boriquen Aquaculture Inc.

Both Ahi Nui and Ahi Farms plan to farm yellowfin and bigeye tuna using surface cages. Ahi Nui submitted its Federal and state permit applications and state lease request, with Environmental Assessment, in July 2002 (HDLNR and DA 2003). The company initially proposed to place floating cages in a conservation area 4.5 miles northwest of Kawaihae Harbor in West Hawaii in approximately 170 feet of water (HDLNR and DA 2003). The total area of the site would have been 216 acres and the cages would have occupied 16 acres of surface water (HDLNR and DA 2003). However, the company dropped its plans for the original site because of public opposition. As of December 2004, the company was in the process of requesting a lease for another site located several miles offshore and in very deep water, and was preparing a new Environmental Assessment (HDLNR and DA 2004).

Ahi Farms applied to lease two sites a mile offshore Kepuhi Point and Maili Point in 2003. The company proposed to establish two sites of 80 acres each that can hold up to 18 cages about 660 feet in circumference and 50 to 60 feet wide in waters with a depth of approximately 100 feet. As of December 2004, it had submitted its Federal permit application with the Army Corps of Engineers and was waiting for approval of its State Conservation District Use Application, with attached Environmental Assessment (HDLNR 2004).

Another company, Pacific Ocean Ventures, prepared an offshore lease application to grow moi and kahala in cages off the coast of Maui (HDLNR and DA 2007). The company's proposal includes placing a cage in the Hawaiian Islands Humpback Whale National Marine Sanctuary. However, the Advisory Council of the Hawaiian Islands Humpback Whale National Marine Sanctuary did not accept the company's Environmental Assessment at a meeting in May 2005, because the company's propsosed site was in a "dense whale area that tends to have more mothers and calves." In 2005 and 2006, the company focused on developing a prototype hatchery for moi and kahala, and continued to look for other sites to place their cage farm (HDLNR and DA 2007).

Boriquen Aquaculture Inc. is located off the northwest coast of Puerto Rico. According to their website, they are currently completing there permitting process for a 51 acre site. This site would provide for the installation of 8 seacages for growout of cobia and pompano (http://www.boriquenaquaculture.com/).

In August 2003, Hubbs-Sea World Research Institute (HSWRI) leased part of an oil platform in the EEZ 10.5 nautical miles off the coast of Ventura, California, in the eastern Santa Barbara Channel with the intent to conduct a 3-year project to test the feasibility of using offshore platforms for the development of marine aquaculture (www.gracemaricultureproject.org). The Grace Mariculture Project, so named because it

would operate from Platform Grace, would raise up to 300 metric tons a year of white sea bass, striped bass, rockfish, California halibut, California yellowtail and bluefin tuna, and shellfish such as mussels and abalone (Miller 2004). The aquaculture project would use 10,000 square feet of deck, which is one-third of the platform's four decks, and place 4 submerged cages, each measuring 125,000 cubic meters, off the platform (Miller 2004).

According to the project description, the permitting process was expected to take place between January 2004 and August 2004, and upon approval, the project was expected to begin with cage and tank equipment delivery and assembly between April 2004 and December 2004. Nursery and grow-out were expected to begin in October 2004 (HSWRI, undated). As of October 25, 2005, HSWRI's Grace Mariculture Project has not been permitted. However, this may be due to the complicating factor that Crystal Energy, which also leases Platform Grace, began to use the platform as an LNG import and regasification facility. Therefore, HSWRI is currently pursuing other options that may not be associated with an oil and gas platform.

Currently Applying for Permits in the Gulf

There are currently no permit applications seeking to construct offshore aquaculture operations in the Gulf EEZ.

Past and Proposed Operations in the Gulf of Mexico, State and Federal Waters

The first offshore finfish aquaculture operation in the Gulf of Mexico was an experimental operation in Texas waters in the late 1980s and early 1990s. Texas Sea Grant scientists used an Occidental Petroleum Corp. (Oxy) platform to grow redfish (Waldemar Nelson International Inc. 2001). Severe storms damaged some of the cages and fish escaped (Burdeau 2005). According to an aquaculture specialist at Texas A&M, the cost of growing out the fish exceeded the market value of the harvest: the ocean-raised redfish worked out to a cost of $22 per pound, whereas the market price for redfish was only $3.50 per pound (Burdeau 2005).

The second entity to propose offshore aquaculture operations in the Gulf and to begin the permitting process was Sea Pride Industries (Sea Pride), which proposed in the late 1980s and early 1990s to develop and operate offshore finfish farms in Alabama, Florida, and Mississippi waters in the Gulf of Mexico. On February 24, 1992, the Mississippi Department of Wildlife, Fisheries and Park granted a permit to Sea Pride to set up an aquaculture operation on a 40-acre site 3 miles south of Horn Island (Leffler 1992). However, the company lacked the venture capital and funding to cover the approximately $5 million in set-up costs (Leffler 1992). On November 3, 1993, the ACOE, Mobile District, gave final approval to one of Sea Pride's projects; however, after receiving that approval, NOAA Fisheries Service expressed objection that there had been insufficient opportunity for comment (Waldemar Nelson International Inc. 2001). According to an October 23, 1995, article in Forbes, Sea Pride Industries, Inc., of Gulf Breeze, Florida, was planning to operate a finfish farm 4 miles southeast of Alabama's Fort Morgan

peninsula (Flanagan 1995). However, Sea Pride's projects never materialized and its ACOE permit expired November 3, 1996.

The third and fourth applicants to propose offshore finfish aquaculture operations in the Gulf were Watermark Corporation (Watermark) and Marine Artificial Habitats, Inc. (Marine Artificial), which submitted applications to the ACOE, New Orleans District, in 1994 (Waldemar Nelson International Inc. 2001). Watermark proposed to establish a platform-supported fishery in Grand Isle Blocks 75 and 76 off the coast of Louisiana. The ACOE returned the application to the company on January 12, 1995. Marine Artificial proposed to establish a privately managed artificial reef and processing plant in South Timbalier 176. Its application was denied and then withdrawn by the applicant.

The previous applicants did not seek to establish offshore finfish operations in Federal waters. The first applicant to propose an offshore finfish aquaculture operation in the Gulf of Mexico EEZ was Seafish Mariculture L.L.C. (SeaFish Mariculture), which received final approval from the ACOE, Galveston District, on July 3, 1997 (Waldemar Nelson International Inc. 2001). A week later, NOAA Fisheries Service published in the *Federal Register* a notice of receipt of SeaFish Mariculture's application for an EFP and a requested public comments (62 FR 132). In its application for an EFP, SeaFish Mariculture stated its purpose was to study over a 26-month period whether it is feasible to grow commercial quantities of native fish species in the offshore environment of the Gulf of Mexico using aquaculture techniques. To do so, it would place hatchery-raised juvenile fish in 3 cages attached to working oil and gas platforms located approximately 48 nautical miles south-southwest of Freeport, Texas; feed them; allow them to grow for approximately 12 months; harvest them from the cages; land them in Texas; and sell them.

SeaFish Mariculture received the first EFP for a marine finfish aquaculture project in the Gulf EEZ in October 1997. The EFP authorized SeaFish Mariculture to harvest, possess, and sell red drum (*Sciaenops ocellata*), greater amberjack (*Seriola dumerili*), and red snapper (*Lutjanus campechanus*) from Federal waters of the Gulf, to possess or sell greater amberjack or red snapper below the minimum size limit, and to harvest or possess red snapper in excess of established trip limits and/or during a closed season. Although SeaFish Mariculture successfully raised red drum from 3-inch hatchery raised fingerlings to market-size fish in a growth cycle of less than 12 months, the project did not make the progress as projected in the permit application. The first group of red drum fingerlings was stocked on November 30, 1997 (Hendrix 1998a). Operations were disrupted by tropical storms and hurricanes in 1998 (Hendrix 1998b). In fact, fish were either killed or escaped when the first cage was damaged by two storms and later destroyed by a tropical storm (Hendrix 1998b). Another unanticipated loss of fish occurred during an attempt to move the cage as requested by Shell Offshore Services, Inc., which operated the platform, and which needed the cage to be moved in order to give its work boats clear access to the platform (Hendrix 1999). In July 1999, SeaFish Mariculture notified NOAA Fisheries Service that it planned to terminate the project as a result of increased gas production at the site.

In September 1998, the Gulf Marine Institute of Technology (GMIT) and its partner, BioMarine Technologies, Inc. (BioMarine), received approval from the Texas General Land Commissioner to use a 500-acre, four-platform oil and gas complex 10 miles southeast of Matagorda Peninsula to develop techniques to grow finfish in Texas waters (Poruban 2000; Dewhurst v. Gulf Marine Institute of Technology). In June 1999, the ACOE delivered GMIT's permit to acquire and convert an existing oil and gas platform to an offshore aquaculture operation (GMIT 2007). However, in October 1999, the Texas General Land Commissioner ordered GMIT and BioMarine to dismantle the platform within 120 days of July 1999, which was the date that the former lease was terminated (Poruban 2000). In response, GMIT and BioMarine sued the Texas General Land Commissioner. In a September 4, 2005, press release, GMIT and BioMarine announced that they had won their lawsuit and intended to proceed with a sea farming research and development project using the platform.

NOAA Fisheries Service and the Gulf Council received the second EFP request for marine finfish aquaculture in the Gulf EEZ in 2003. Florida Offshore Aquaculture, Inc. proposed using four submerged sea cages 33 statute miles WSW of Johns Pass, Florida, to grow cobia, red snapper, Florida pompano, cubera snapper, greater amberjack, and mahi mahi. The Gulf Council considered the EFP request at their September 2003 meeting and recommended the EFP application be denied. The Council, as well as environmental organizations and individuals, identified numerous issues of concern, which are described in a December 23, 2003, Federal Register Notice (68 FR 246). In summary, it was concluded the applicants lacked the experience to comply with EFP conditions and had submitted false information in the application.

At its November 2003 meeting, the Gulf Council adopted a marine aquaculture policy for the Gulf of Mexico EEZ. The Gulf Council's policy encourages environmentally responsible marine aquaculture (GMFMC 2003).

3.0 Purpose and Need

Aquaculture in federal waters is considered "fishing" under the MSFCMA. While current regulations authorize NOAA Fisheries Service to grant experimental fishing permits (EFPs) for aquaculture in federal waters, such permits are of limited duration and are not intended for the large-scale production of fish. As a result, commercial aquaculture in federal waters is not viable under the current permitting process. Federal fishery management plans (FMPs) must be amended to authorize the development of commercial aquaculture operations if aquaculture is to become a viable industry in federal waters.

Congress is currently debating national legislation that would authorize and establish a regulatory framework for commercial aquaculture in federal waters. The current bill, titled the National Offshore Aquaculture Act of 2007 (Appendix B), would exempt aquaculture from the MSFMCA definition of "fishing" and provide regional fishery management councils a consultative role in the development of an offshore aquaculture industry. The bill would take several years to implement, even if enacted into law this

year, and would not override other existing laws and regulations intended to conserve and manage wild fish stocks.

The purpose of this Generic Aquaculture Amendment is to maximize benefits to the Nation by establishing a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico. The Council initiated this action to provide a programmatic approach to evaluating the impacts of aquaculture proposals in the Gulf of Mexico and a comprehensive framework for regulating such activities. The amendment and associated programmatic environmental impact statement (PEIS) are intended to streamline the regulatory process for authorizing current and future offshore aquaculture proposals by providing the Council and NOAA Fisheries Service the information required to review and authorize offshore aquaculture operations on a case-by-case basis.

The primary goal of the Council's proposed aquaculture permitting program is to increase the maximum sustainable yield (MSY) and optimum yield (OY) of federal fisheries in the Gulf of Mexico by supplementing the harvest of wild caught species with cultured product. This amendment would define the following new objective for five of the Council's 7 FMPs (would not include Coral and Coral Reefs FMP or Shrimp FMP): Provide for the development of environmentally sound and economically sustainable aquaculture operations to increase the potential yields of the fishery, consistent with the goals and objectives of the MSFMCA.

Supplementing the harvest of domestic fisheries with cultured product will help the United States meet consumers' growing demand for seafood and may reduce the nation's dependence on seafood imports. Currently, the United States imports over 80 percent of the seafood consumed in the country, and the annual U.S. seafood trade deficit is at an all time high of over $9 billion. One-half of imported seafood products are produced by aquaculture operations. This worldwide trend toward aquaculture production is expected to continue in response to consumers' continued demand for safe, healthy seafood.

The primary goal of federal fishery management, as described in National Standard 1 of the MSFMCA, is to conserve and manage U.S. fisheries to "...prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry". OY is defined as the amount of fish that provides the greatest net benefits to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems. While economic and social factors are to be considered in defining the OY of each fishery, OY may not exceed MSY, or the maximum amount of fish that can be removed without impairing the fishery's ability to replace removals through natural growth or replenishment. OY must prevent overfishing and, in the case of an overfished fishery, must provide for rebuilding stock biomass to a level consistent with that which would produce MSY.

The MSY and OY of each Council-managed fishery are currently limited by the fishery's biological potential. However, adding an aquaculture component to Council-managed

fisheries would increase the total yields these fisheries could produce to the amount of fish harvested from wild stocks plus those fish produced by aquaculture operations. Increasing the seafood production potential of these fisheries will increase their contributions to national, regional, and local economies, and their capacity to meet the Nation's nutritional needs.

The environmental permitting, reporting, recordkeeping and siting conditions associated with the proposed aquaculture program are consistent with the Council policy to encourage environmentally responsible marine aquaculture. These conditions are intended to ensure the operations of all offshore aquaculture facilities permitted in the Gulf of Mexico are consistent with the MSFCMA National Standards (Section 6.10) and do not compromise Council objectives for wild fisheries to:

1. Stabilize or sustain wild stocks over the long term (Spiny Lobster FMP (1982), Coastal Migratory Pelagics FMP (1983), Red Drum FMP Amendment 1 (1987), Reef Fish FMP Amendment 1 (1990));
2. Rebuild overfished stocks (Reef Fish FMP (1984));
3. Conserve and protect fish habitat (Reef Fish FMP (1984), Red Drum FMP Amendment 1 (1987));
4. Minimize impacts on protected species, consistent with the requirements of the Endangered Species Act and Marine Mammal Protection Act (Shrimp FMP (1981)); and
5. Minimize user conflicts (Stone Crab FMP (1979), Spiny Lobster FMP (1982), Coastal Migratory Pelagics FMP Amendment 1 (1985), Reef Fish FMP Amendment 1 (1990)).

These conditions will assist the Council in promoting the development of a robust commercial aquaculture industry in the Gulf of Mexico, without threatening the long-term sustainability or viability of wild fisheries or their contributions to the local, regional, and national economies.

4.0 Management Alternatives

The following section provides a discussion of the eight actions considered by the Council for this Generic Amendment to their FMPs to provide for regulation of offshore marine aquaculture. Section 6.0 examines the various actions and their alternatives relative to each other within the physical, biological, ecological, economic, social, and administrative environments. Appendix D provides a list of alternatives the Council considered, but rejected and the rationale for not including those alternatives. Appendix E provides a list of economic terms used throughout this section and Sections 6-8.

4.1 Action 1: Types of Aquaculture Permits Required

Alternative 1: No Action, an Exempted Fishing Permit (EFP) for conducting aquaculture would be required.

Preferred Alternative 2: Require a NOAA Fisheries Service permit to operate a marine aquaculture facility in the Gulf of Mexico EEZ.

Alternative 3: Require separate NOAA Fisheries Service siting and operating permits for an aquaculture facility in the Gulf of Mexico EEZ. A siting permit would specify the duration, size, and location of a marine aquaculture facility and an operating permit would specify the marine species to be propagated, reared, or both, and design, construction, and operational details.

Discussion and Rationale

Section 6.2 examines the various Action 1 alternatives relative to each other within the biological, physical, ecological, economic, social, and administrative environments. **Alternative 1**, the no action alternative, would maintain status quo regulations, which require an EFP to conduct marine aquaculture and other activities as described in 50 CFR 600.745. The EFP (Appendix A) is not intended to be used for commercial production of fish. Additionally, an EFP is typically issued for no longer than one year, which is generally considered too short of a period for a lending institution to finance construction of most aquaculture facilities. While renewal is permitted under 50 CFR 600.745 (presumably in one-year increments), uncertainty as to whether the permit will be renewed would add to the uncertainty of the business venture and, hence, deter otherwise potential business ventures. For these reasons, it is unlikely that a viable commercial aquaculture industry could develop in the Gulf of Mexico.

Preferred Alternative 2 would require a NOAA Fisheries Service permit to operate an aquaculture facility in the Gulf of Mexico EEZ. NOAA Fisheries Service would review applications for an aquaculture permit and determine if the information provided by the applicant is sufficient to issue a permit. Aquaculture operations would be required to meet permit conditions described in Action 3 before receiving a permit. Additionally, NOAA Fisheries Service would ensure appropriate species and reliable grow-out systems were used for aquaculture, as specified in Actions 4 and 5, and evaluate if an aquaculture operation is sited in an appropriate location that would minimize or prevent environmental impacts (see Action 6). Upon issuance of a permit, aquaculture operations would be required to maintain records as described in Preferred Alternative 2 of Action 8 and submit an annual report to NOAA Fisheries Service. Not complying with these requirements could result in revocation of a permit prior to its date of expiration.

Alternative 3 would require NOAA Fisheries Service issue separate siting and operating permits. Siting criteria described in Action 6 would be used as the basis for issuing or not issuing a siting permit. These criteria would be in addition to or consistent with the criteria of other agencies, notably the ACOE and EPA. Requiring a siting permit would be partially duplicative of the ACOE permit process, since the ACOE issues permits for siting. However, there would be a key difference in these two processes; under **Alternative 3**, NOAA Fisheries Service would have authority to disapprove an application based on siting criteria specified in Action 6, whereas NOAA Fisheries Service currently only reviews and provides comments on permits submitted to the

ACOE for review. Conditions for issuing an operational permit would be similar to those described in **Preferred Alternative 2**.

Both **Preferred Alternative 2** and **Alternative 3** would allow for the development of a commercial aquaculture industry in the Gulf EEZ. In addition to the permit(s) NOAA Fisheries would require, additional permits may be required by the ACOE (siting), EPA (pollution discharge, water quality), USCG (navigation), MMS (use of oil and gas platforms), and FDA (antibiotics and other therapeutics).

Establishing a permitting process for offshore aquaculture would allow the Council to better achieve National Standard 1 and the primary goal of this amendment, which is: "to maximize benefits to the Nation by establishing a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico." The MSFCMA mandates that NOAA Fisheries Service conserve and manage U.S. fisheries to "...prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry". The MSY and OY of each Council-managed fishery are currently limited by the fishery's biological potential. Adding an aquaculture component would increase the total yields these fisheries could produce, thereby contributing to national, regional, and local economies, and their capacity to meet the Nation's nutritional needs.

The actions and preferred alternatives in this amendment associated with the proposed aquaculture program are consistent with the Council policy to encourage environmentally responsible marine aquaculture. These conditions are intended to ensure the operations of all offshore aquaculture facilities permitted in the Gulf of Mexico are consistent with the MSFCMA National Standards (Section 6.10) and do not compromise Council objectives for wild fisheries (see Section 3.0). Additionally, these conditions will assist the Council in promoting the development of a robust commercial aquaculture industry in the Gulf of Mexico, without threatening the long-term sustainability or viability of wild fisheries or their contributions to the local, regional, and national economies.

This additional production of seafood could also assist the Council in preventing overfishing, by decreasing fishing pressure on some wild stocks. Additionally, certain aquaculture operations operating in the EEZ may engage in stock enhancement practices of certain species, particularly those whose stock status determination criteria have found the stock to be overfished and/or undergoing overfishing, thereby potentially improving their status and helping to achieve MSY and OY.

Summary Comparison of Physical, Biological, and Ecological Consequences

Section 6.1 provides a detailed description of the potential impacts associated with marine aquaculture on the physical, biological, and ecological environments. These include, but are not limited to:

1) Modification of wild stock genetic diversity;
2) Transmission of infectious disease to wild stocks;

3) Modification of benthic habitat from discharged effluents, such as solids and dissolved nutrients;
4) Escaped fish competing with wild fish;
5) Entanglement of wildlife with aquaculture structures; and
6) Use of bait fishes for feed.

Action 1, by itself would not have any direct effects on the physical, biological, and ecological environments of the Gulf. However, Action 1 will indirectly effect these environments. **Alternative 1** would restrict the development of offshore aquaculture in the Gulf and therefore would result in no impacts to the physical, biological, and ecological environments unless an aquaculture facility was able to successfully develop an operation under the current EFP permitting process. Only one EFP permit has ever been issued by NOAA Fisheries Service to conduct marine aquaculture in the Gulf (see Section 2.2). Currently, no aquaculture operations have an EFP permit to conduct aquaculture in the EEZ and there is no expectation that aquaculture operations could develop a successful business under the EFP permitting process. Therefore, the potential impacts described in Section 6.1 would not occur.

Alternatives 2 and 3 would create a permit process and therefore would indirectly effect the physical, biological, and ecological environments by allowing the development of an aquaculture industry. Impacts to the physical and biological environments, as described in Section 6.1, would depend on numerous factors, including where a facility is sited, the potential for fish escapement, the business practices of an operation, etc. Permitting marine aquaculture in the Gulf (**Alternatives 2** and **3**) would have greater impacts than the status quo alternative (**Alternative 1**). However, measures considered in this amendment are intended to mitigate or prevent impacts to wild Gulf resources resulting from marine aquaculture. Such measures include stringent permit conditions and recordkeeping requirements, a requirement to use only native, non-transgenic species for culture, and case-by-case review of allowable marine aquaculture systems (see Actions 3, 4, 5, 6, and 8).

Conducting aquaculture offshore is desirable for two main reasons: 1) First, there are fewer competing uses further from shore, and 2) second, the deeper water and stronger water flows make it a more desirable location for mitigating environmental impacts, such as nutrient loading. As discussed in Section 6.1.3, the EPA has authority to set water quality parameters for pollution discharge and has developed standards for fish farms in the United States (see Appendix H). The two greatest perceived risks to water quality and the benthic environment resulting from offshore aquaculture are increased organic loading to the benthos and nutrient enrichment of the water column. Recent environmental studies off Puerto Rico and New Hampshire indicate nutrient and organic loading tends to be localized around aquaculture cages and not significantly different from nearby control sites (Alston et al. 2005; Rapp 2006; UNH Marine Aquaculture Center 2006).

Other potential physical and biological impacts resulting from aquaculture include escapement of fish, competition with wild stocks, spread of disease, benthic habitat

damage, increased use of bait fishes for aquaculture fish meal, and entanglement of wildlife. Non-native and genetically modified species can pose a threat to both wild stocks and biodiversity by competing for food and habitat and changing community and genetic structure. To address this risk, the Council proposes using only native, non-genetically modified species for aquaculture in the Gulf of Mexico (see Section 4.4). Because most offshore aquaculture will be conducted in net pens or cages that allow water to move freely through these grow-out systems, potential for the spread of disease exists. Disease outbreaks have been observed in farmed fish. However, there is no scientific evidence to suggest a significant risk of disease transmission from farmed aquatic organisms to wild stocks or from farmed aquatic organisms escaping and intermingling with wild stocks if farmed fish are stocked as disease-free juveniles (see Section 6.1.2). The Council has addressed this potential risk by requiring an aquatic animal health plan for each aquaculture facility (see Section 4.3) and various recordkeeping and reporting requirements if disease outbreaks occur (see Section 4.8).

Benthic degradation may occur through increased organic loading or direct damage from aquaculture facility structures. To prevent or minimize habitat degradation, facilities should be properly sited away from essential fish habitat and other ecologically important areas. Aquaculture operations would be required to meet EPA water quality standards. Additionally, this amendment would provide NOAA Fisheries Service authority to evaluate potential aquaculture grow-out systems and sites on a case-by-case basis (see Section 4.5 and 4.6) to ensure grow-out systems are reliable and operations are sited in areas that minimize impacts to benthic habitat.

Lastly, potential concerns have been expressed about the use of prey species as bait. Worldwide approximately 25-30 million tons of fish are reduced to fish meal and fish oil annually (Tacon et al. 2006). The amount of fish reduced to fish meal has been relatively stable over the past few decades. In 2003, the United States accounted for 5.6 percent of the worldwide fishmeal production and 9.6 percent of the worldwide fish oil production (Tacon et al. 2006). In the United States, Gulf and Atlantic menhaden represent the greatest source of fish meal production. Neither of these species is overfished or undergoing overfishing and both are managed by states and interstate compacts. These species are regularly assessed every four to five years by NOAA Fisheries Service. If demand for these species increases due to development of an aquaculture industry in the Gulf of Mexico and increases in livestock feeds, then stock assessments will be used to assess the status of each of these populations. Necessary management adjustments could then be made to protect these species if fishing mortality is to high or stock biomass has dropped below threshold levels.

For more information on the above described physical and biological impacts see Section 6.1.

Summary Comparison of Socioeconomic and Administrative Consequences

The current permitting process has been described by Bunsick (2003), the University of Delaware (2006), and in the EIS of this amendment. Those permit requirements are included here by reference. Permits required by federal agencies other than NOAA

Fisheries Service would still be needed before a firm could establish an offshore aquaculture facility in the GOM EEZ.

Under NOAA Fisheries Service requirements to raise and harvest federally managed species from the Gulf of Mexico EEZ, the harvester must either follow the current management regulations or obtain an EFP to operate outside those regulations (i.e., exceed the bag limits, trip limits, time and area, closures, permit requirements, etc). Current regulations require an aquaculture firm raising and harvesting fish in the GOM EEZ to obtain an EFP for that activity. EFPs may be issued for one year, with the RA having the option of renewing the permit if the appropriate application is submitted. The EFP program was not developed with the idea of enabling offshore aquaculture facilities to operate indefinitely. Using the EFP structure to accommodate the development of offshore aquaculture businesses has not been successful. Continuing to use the EFP program to enable aquaculture firms to operate in the Gulf EEZ will inhibit the development and growth of an offshore aquaculture industry in federal waters of the Gulf.

Offshore aquaculture production in the Gulf EEZ is not expected to develop under the status quo permitting system. Commercial fishers in the GOM would continue to harvest and sell their catch into traditional markets. As production of substitute products are developed through wild harvest outside the GOM or aquaculture (domestic production or imports) ex-vessel prices could decrease. The amount prices and revenues decline will depend on the own-price and cross-price flexibility of the various products.

Alternative 2 would create a new permit that would be issued by the RA on behalf of the Secretary of Commerce. The permit would be required before a person could develop an offshore aquaculture facility in the Gulf EEZ. Both siting and operational authority would be granted under the permit. The permit would not allow its holder to harvest fish in the commercial or recreational fisheries (with the exception for harvest of broodstock), but would indicate the permit holder has met all of the NOAA Fisheries Service requirements (see Section 4.3) to grow and harvest fish at their facility. The permit could be revoked if the holder does not fulfill the requirements for holding and using the permit.

The costs of obtaining a permit under either **Alternative 2** or **Alternative 3** (a separate permit is issued for siting and operation of the facility) are expected to be about the same. The same information would be required from the applicant under both structures. NOAA Fisheries Service would need to determine whether sufficient siting and operation information is provided before the permit could be issued. Under **Alternative 3**, a siting permit could be issued when all of the siting requirements (see Action 6) are met and the operational permit could be issued when that portion of the application is approved. It is important to note that business would not be allowed to operate until both permits are issued. An EFP would not be required for the permitted activities.

The overall economic impact that could result from issuing aquaculture permits for the Gulf EEZ can not be projected with any certainty. A lack of information currently

available regarding the viability and structure of these potential operations restricts the analysts to a qualitative discussion of impacts. Development of the industry may help offset anticipated future increases in imports. Historic import trends show that U.S. imports of seafood have grown by about $4 billion from 1995 to 2004 (USDA, 2006); U.S. per capita consumption of seafood increased by 0.3 pounds per person over that time period.

As the aquaculture technology to raise reef fish species, grouper, tuna, etc. is improved, imports of those products will likely increase. When production of those species takes place outside the U.S., the economic activity associated with that production would not benefit communities close to the Gulf. Commercial harvesters competing in the market could realize reductions in ex-vessel prices and revenue. The changes in commercial ex-vessel price changes under the status quo and **Alternative 2** and **3** cannot be predicted with information that is currently available, but may be somewhat smaller under the status quo. Producer surplus would be generated if aquaculture firms earn economic rents (this is more likely to occur earlier in the development of the industry or if permits limit competition).

Alternative 3 requires a person to obtain separate NOAA Fisheries Service siting and operating permits before they could install and operate an aquaculture facility in the Gulf EEZ. The proposed siting location would be reviewed on a case-by-case basis as discussed in Action 6. The operating permit would regulate marine species that could be propagated and/or reared and the design, construction, and operational details of the business. Operational permits could be linked to a specific site permit. This amendment would require an operating permit for use at a specific site be used within two years of issuance or it would be revoked as discussed in Action 3.

The economic costs and revenues are expected to be the same under **Alternatives 2** and **3.** Both have the potential to provide a structure that could create a new aquaculture industry in the Gulf. The feasibility of creating those businesses is still uncertain, based on the literature currently available.

The creation of a permitting system will have a direct effect on the administrative environment, though the extent of that effect is difficult to determine due to the uncertainty in the number of applicants expected to apply for a permit. Despite this, a permit is almost completely administrative in nature and therefore is expected to have a direct effect on the administrative environment. The administrative burden on NOAA Fisheries Service regional office staff and state/federal law enforcement officers would increase due to the review, issuance, and enforcement of offshore aquaculture permits.

4.2 Action 2: Duration of the Permit

Alternative 1: No Action, Exempted Fishing Permits are effective for no longer than one year unless otherwise specified in the EFP or a superseding notice or regulation.

Preferred Alternative 2: Aquaculture permits are effective for:

	a) 5 years
Preferred	**b) 10 years and may be renewed in 5 year increments**
	c) 20 years
	d) Indefinitely.

Discussion and Rationale

Alternative 1 would retain the current effective period of an EFP, which is one year unless otherwise specified. **Preferred Alternative 2** would establish a different effective period ranging from 5 years (**Alternative 2a**) to indefinitely (**Alternative 2d**).

The duration of permit issuance is primarily an economic consideration, although it could have ramifications to the physical and biological environments if a permit is not regularly reviewed for compliance with governing regulations. Actions 3 and 8 in this amendment require operations comply with several permit conditions, recordkeeping requirements, and reporting requirements. These requirements and conditions will alert NOAA Fisheries Service of potential problems occurring at a facility and provide them with a basis for either revoking a permit or requiring a facility to change its business practices in order to prevent unacceptable impacts to the biological, physical, and/or ecological environments. Additionally, it is anticipated NOAA Fisheries Service staff will conduct on-site visits to facilities on a semi-annual basis to review operations. If, at any time, permit conditions or recordkeeping and reporting requirements are not being met, NOAA Fisheries could initiate an on-site inspection to determine the operations impact and, if needed, revoke the operation's permit prior to its expiration. Therefore, the duration of the permit is of primary importance for business planning purposes and not for monitoring effects on the physical, biological, and ecological environment.

Short permit durations (less than ten years) would make it: 1) difficult to obtain financing for aquaculture operations and 2) undesirable for investors to commit money to such operations. Offshore aquaculture entrepreneurs will, in many instances, need to finance their operations. Lenders will provide financing only if there is sufficient certainty that the aquaculture operation can pay principal and interest on any loans. Obtaining capital has been a problem for offshore aquaculture entrepreneurs. Longer permit durations are expected to reduce risk costs associated with short-term output fluctuations and/or market fluctuations, which would increase the likelihood of entrepreneurs obtaining financing. Even if financing is available, costs will accrue each time a permit is renewed, so longer renewal periods will minimize costs (National Standard 7). Ten years is considered by many to be the minimum timeframe necessary for an operation to be profitable and obtain sufficient investment and financing.

Summary Comparison of Physical, Biological, and Ecological Consequences

The duration of permit issuance will not have any direct effects on the physical, biological, or ecological environments. However, Action 2 will have indirect effects on these environments. As discussed above, the duration of the permit is of primary importance for business planning purposes and not for monitoring effects on the physical, biological, and ecological environments. Regardless of the length of the permit, NOAA Fisheries Service will regularly (at minimum annually) review operations for compliance

with governing regulations. Operations will be required to meet permit conditions specified in Action 3 and recordkeeping and reporting requirements specified in Action 8. Additionally, it is expected NOAA Fisheries Service staff will conduct site visits at facilities to ensure operations are operating properly and not causing unacceptable impacts to the physical, biological, and ecological environments. For these reasons, the effects on these environments are expected to be similar for all alternatives in Action 2. However, **Alternative 1** would provide the shortest period for permit issuance of any of the alternatives, and therefore would allow NOAA Fisheries Service to not renew a permit, rather than revoke a permit, if an operation was determined to be causing negative environmental impacts to the physical and biological environments. **Alternatives 2(a)** through **2(d)** would allow permits for 5, 10, or 20 years, or indefinitely. If NOAA Fisheries Service encountered problems with revoking a permit before it expired, then shorter permit durations would be more beneficial to the physical and biological environments, than longer permit durations, because NOAA Fisheries Service could decide not to renew a permit after it expired.

Summary Comparison of Socioeconomic and Administrative Consequences

Because offshore aquaculture will likely have significant costs in years prior to the generation of any revenue, the permit holder needs some certainty regarding recouping upfront costs and earning a positive return on his investment. The timeframe needed to generate an acceptable revenue stream and realize a positive return on investment is likely to vary by species. Faster growing species will generate revenues sooner, but it does not necessarily translate into the realization of a more rapid positive return on investment. Any permit that limits the duration to less than that needed to realize a profit may potentially limit the species that would otherwise be grown. Investment in production and new technology is expected to decrease in relation to the amount of time remaining before the permit expires.

Offshore aquaculture entrepreneurs will, in many instances, need to finance their operations. Lenders will provide financing only if there is sufficient certainty that the aquaculture operation can pay principal and interest on any loans. Obtaining capital has been a problem for offshore aquaculture entrepreneurs because of the lack of regulatory certainty or the lack of a permit framework for federal waters. Longer permit durations are expected to reduce risks costs associated with short-term output fluctuations and/or market fluctuations, which would increase the likelihood of entrepreneurs obtaining financing.

Optimal permit duration depends upon the Council's objective(s) associated with this amendment. Since the primary purpose is "… to maximize benefits to the Nation by establishing a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico," permits that are developed should ensure that entrepreneurs are given a reasonable amount of time to generate sufficient returns to justify financial institutions to invest in the industry.

Under the No Action or status quo alternative (**Alternative 1**), the permit will expire after one year, unless otherwise noted. The uncertainty of renewal means that lending institutions are unlikely to finance offshore operations. Higher net national benefits could be achieved with longer permit durations.

Under **Alternative 2**, the range of options varies from 5 years to 20 years with one additional option of an indefinite period[2]. Five years (i.e., **Alternative 2(a)**) of investment for some species is likely to be too short to realize a positive return on investment. Therefore, **Alternative 2(a)** would likely limit grow-out options available to entrepreneurs, particularly for slower growing species. A 5-year permit, even if profitable, will surely stifle any investment in new technology, therefore limiting the permit duration to 5 years is unlikely to achieve the purpose of this amendment.

Under **Preferred Alternative 2(b)**, permit effectiveness would be for 10 years. Increasing the duration of the permit will allow sunk costs to be spread out over a longer time period implying lower fixed costs per year of operation. In that regard, **Alternative 2(c)** (20 year permit) would typically be preferable to **Alternative 2(b)** in achieving the purpose of this amendment. However, **Preferred Alternative 2(b)** strikes a balance between economic/social benefits and concerns about biological impacts. Under **Alternative 2(d)**, permit effectiveness would be 'indefinite.' and would begin to mimic the dimensions of pure property rights. However, the permit may be terminated during this period for failure to comply with the permit conditions under Action 3, **Preferred Alternative 3,** and recordkeeping and reporting requirements under Action 8, **Preferred Alternative 2**. As inferred property rights are strengthened with duration, expected investment will be enhanced. This represents not only upfront investment, but also long-term investment. This option would likely provide the greatest net national benefits.

The likelihood of unacceptable economic effects on owners of aquaculture facilities and administrators is expected to decrease as the effective period of an aquaculture permit increases. Detrimental socioeconomic consequences, and administrative costs of permit renewal, are most likely highest if permits are effective for five years (**Alternative 2(a)**), and least likely if permits are effective for an indefinite period (**Alternative 2(d)**). Therefore, the alternatives in order from least detrimental economic and social effects to most detrimental are as follows: **Alternative 2(d)**, **Alternative 2(c)**, **Preferred Alternative 2(b)**, **Alternative 2(a)**, and **Alternative 1**.

The administrative burden of reviewing applications for permit renewals decreases as the length of time between renewals increases. Therefore, **Alternative 1** has a greater negative impact than **Alternative 2** on the administrative environment. **Alternative 2(d)** has the least impact on the administrative environment, followed by **Alternatives 2(c)**, **2(b)**, and **2(a)**.

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2 For purposes of comparing the different permit effectiveness (i.e., duration) it is implicitly being assumed that the permits are not renewable.

4.3 Action 3: Permit Conditions

Alternative 1: No Action, do not specify permit conditions.

Alternative 2: Require the Exempted Fishing Permit conditions as specified at 50 CFR 600.745(b) (3) (v).

Preferred Alternative 3: Establish the following permit conditions:

a) Obtain an assurance bond for the removal of aquaculture structures as a condition of permit issuance. NOAA Fisheries Service will develop a mechanism for requiring a bond, as appropriate.

b) Describe plans for the following:

- **i. Limit genetic impacts on wild Gulf stocks. Required components of the plan would include: 1) the source of brood fish for fingerling production by geographic area, 2) the frequency broodstock are replaced, 3) and whether any cultured fish will be raised to sexual maturity.**
- **ii. Aquatic animal health management. Required components of the aquatic health management plan would include: 1) identification of an animal health management expert and frequency of visits, 2) procedures for notifying NOAA of reportable disease, 3) procedures for prestocking health inspections of aquatic animals, and 4) freezing or refrigerating diseased animals so they are available for inspection. "Diseased" animals are those infested with parasites and/or infected by bacteria or virus.**
- **iii. Collecting and spawning broodstock and rearing fingerlings. Required components of the plan would include: 1) a description of the culture facility, if spawning and rearing activities will occur at a location other than the culture facility; 2) the number species, and size of brood stock proposed to be captured and the methods/gears used for capturing, holding, and transporting broodstock; 3) anticipated size to which fingerlings will be raised; and 4) a list of names and addresses for spawning and rearing facilities used to obtain fingerlings and any relevant aquaculture permit numbers.**
- **iv. Environmental monitoring. Required components of the plan would include: 1) a plan for interactions with threatened or endangered species, 2) a description of how environmental impacts would be monitored, and 3) compliance with EPA standards.**
- **v. Emergency disaster plan for hurricanes, net or cage failure/escapement, or pollution event.**

c) **Improve law enforcement capabilities. Components would include: 1) Any vessel authorized for use in aquaculture operations must have an aquaculture permit onboard, 2) notification of the time, date, and port of landing must be given to law enforcement at least 3 hours prior to landing, 3) a record of the number of fish raised for aquaculture (number of fingerlings placed in growout for market) must be maintained, 4) require submission of fin clips from broodstock used in spawning of fingerlings.**

d) **A use it or lose it provision for permits based on development of operations within 2 years of issuance of the permit. Development of operations is considered to be occurring when aquaculture equipment is obtained and placed in the water**

e) **Other permit conditions:**

i. Applicant must provide names, addresses and phone numbers of captains and vessel owners, along with project vessel(s) documentation or identification numbers. As a condition for maintaining the permit the applicant agrees to notify NOAA Fisheries Service if there are any changes in company owners, captains and/or vessel owners;

ii. Applicant must describe the exact location of the facilities and any associated pens or enclosures using GPS coordinates and the species of fish to be cultured;

iii. Applicant must agree to maintain a minimum of one locating device on each pen or enclosure and immediately notify NOAA Fisheries Service in the event the pen or any retention aquaculture enclosure is lost at sea;

iv. Permittee must describe the harvesting equipment necessary for operation and removal of aquaculture fish;

v. The aquaculture operational permit shall specify the conditions under which aquaculture harvesting gear or any type of fishing equipment shall be deployed, retrieved, and stored;

vi. Permittee must notify NOAA Fisheries Service prior to removal and transport of aquaculture fish from the facility to shore;

vii. Aquacultured fish must be maintained with heads and fins intact until reaching the processing facility.

viii. Transport and service vessels, aircraft, and vehicles must have a copy of the aquaculture permit on board; and,

ix. The possession of any wild fish aboard any marine aquaculture facilities, and its transport and service vessels, vehicles, or aircraft is prohibited.

f) Other appropriate permit conditions, as specified by the NOAA Fisheries Service Regional Administrator, necessary for issuance and administration of an aquaculture permit.

Discussion and Rationale

Action 3 considers three permit condition alternatives. **Alternative 1** would not specify any conditions when issuing a permit to an aquaculture facility. **Alternative 2** would require a facility to meet the conditions set forth in an EFP. **Preferred Alternative 3** would require each aquaculture operation to obtain an assurance bond as a condition of permit issuance. This alternative would also aquaculture operations prepare plans for:

1) Managing genetic diversity and limiting genetic impacts on wild Gulf stocks;
2) Managing aquatic animal health;
3) Managing broodstock and fingerlings,
4) Monitoring environmental impacts; and
5) Preparing for emergencies, such as hurricanes, escapement events or pollution events.

Additionally, **Preferred Alternative 3** would require operations meet various requirements to enhance law enforcement capabilities; and begin operation within two years of permit issuance. It should be noted that NOAA Fisheries Service will review compliance with permit conditions each year.

Developing a permitting system that requires all information concerning the aquaculture facilities' operations, including species raised, site location, and scale will allow managers and permit review officials to assess the impact a particular facility will have on the physical, biological, and ecological environment. Requiring permit applicants and permit holders to meet specific conditions would not directly affect the physical or biological environments. However, the conditions described in Action 3 would indirectly affect the physical and biological environments. **Alternative 1** would not specify permit conditions and therefore would provide no protection to the natural environment. Operations could conduct their businesses without any safeguards to prevent or mitigate environmental impacts associated with their operation. Relative to **Alternatives 2** and **Preferred Alternative 3**, **Alternative 1** would have the greatest potential indirect effects on the physical and biological environments.

Alternative 2 would require permit applicants and permit holders meet the conditions specified for an EFP (see 50 CFR 600.745). This alternative could only be selected if **Alternative 1** in Action 1 was selected as the preferred. EFP regulations require an applicant to submit the following information: The date of the application, relevant contact information, the species expected to be harvested under the EFP, the amount(s) of such harvest necessary to conduct the exempted fishing, the arrangements for disposition of all regulated species harvested under the EFP, anticipated impacts on marine mammals or endangered species, and a statement of the purposes and goals of the exempted fishery for which an EFP is needed, including justification for issuance of the EFP. Additionally, the EFP applicant must provide documentation for each vessel to be covered by the EFP,

the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used. The RA or Science Center Director, as appropriate, may request additional information for determining issuance of an EFP. **Alternative 2** would afford more protection to the physical and biological environments than **Alternative 1**, but issuance of a permit would be based partly on information specified at the discretion of the RA or Science Center Director.

The conditions specified in **Preferred Alternative 3** are designed specifically to minimize impacts on the physical, biological, ecological, and administrative environments and would therefore be of a greater benefit to these environments than either **Alternative 1** or **2**. Requirements under **Preferred Alternative 3** would give NOAA Fisheries the best scientific information available with which to evaluate ongoing and future aquaculture operations (National Standard 2). In addition, fishing permits would be issued to those applicants that are most likely to ensure the most efficient and economical use of fishery resources (National Standards 5 and 7).

Alternative 3(a) would require permitted aquaculture firms to obtain an assurance bond as a condition of permit issuance. All oil, gas, and mineral extraction firms are required under Minerals Management Service (MMS) regulations to remove platforms and connecting pipe lines and return the ocean bottom to its original configuration. Additionally, the National Offshore Aquaculture Act of 2007 (Appendix B) requires an assurance bond for removal of the aquaculture structures as a criterion of the siting permit. Requiring an assurance bond would eliminate the potential for navigation hazards in the event an operation terminates their business. It would also protect the biological and physical environment by preventing long-term damage to habitat and entanglement of wildlife in derelict gear (National Standard 9). The specific conditions under which NOAA Fisheries Service may require an assurance bond are still unclear. Alternative 3(a), therefore, provides NOAA Fisheries Service authority to develop a mechanism for requiring a bond, as appropriate, once their authority is determined.

Alternative 3(b)(i) requires the permitee to have a plan that would limit the genetic impacts on wild stocks. To ensure genetic diversity is maintained and wild stocks are not adversely affected, aquaculture operations are required to use native, non-genetically modified stocks and select broodstock from the same geographical areas where the fish will be cultured (i.e., fish must be native to the Gulf).

For some stocks that rarely move extensive distances as indicated by otolith microchemistry studies or tagging studies, localized demographic units may develop with genetic divergence as a function of geographical distance. Therefore, for these stocks, it is prudent to utilize broodstock captured from the same areas of the Gulf as the aquaculture will be conducted. Additionally, culturing and regularly replacing fish from native, local broodstock will minimize or prevent impacts to wild stocks in the event of escapement. Negative impacts associated with genetic modification and use of non-native stocks are discussed in Section 6.1.

Alternative 3(b)(ii) requires the permittee to have a plan to maintain aquatic animal health for the fish being cultured. **Alternative 3(b)(iii)** requires the permittee to have a plan for collecting and spawning broodstock and raising fingerlings. **Alternative 3(b)(iv)** requires the permittee to have a plan for environmental monitoring. All of these sub-alternatives would help prevent, or minimize to the extent practicable, impacts of an aquaculture facility on the physical, biological, and ecological environment. Impacts related to fish disease and broodstock collection, spawning, and rearing are discussed in detail in Section 6.1. Briefly, outbreaks of disease are known to occur in cultured fish and escapes of diseased fish have occurred. Currently, there is no scientific evidence that indicates farmed animals that were stocked disease-free pose a risk of transmitting diseases to wild populations. Further, studies have shown that levels of pathogens are rapidly diluted within a few meters of a marine net pen experiencing a disease outbreak (Rose et al. 1989).

A plan for collecting and spawning broodstock and raising fingerlings is necessary to ensure genetic diversity remains similar to the wild stock. Action 4, **Preferred Alternative 4** specifies only native, non-genetically modified species for aquaculture use. A broodstock management plan will allow NOAA Fisheries Service to assess if adequate steps are being taken to maintain genetic diversity. **Alternative 3(b)(iii)** would prevent operations from selecting animals with faster growth rates or greater disease resistance. This is critical in the event of escapement, because losses in fitness would not be experienced because breeding wild and cultured fish would have similar genetic make-ups. Additionally, because the plan would also describe plans for raising and maintaining fingerlings, this will allow NOAA Fisheries Service to assess risks associated with disease.

The requirement to have an environmental monitoring program would allow mangers to examine this data and determine impacts on the physical environment and require changes be made in a facility's operations to correct for any negative impacts. **Alternative 3(b)(v)** requires the permittee to have an emergency disaster plan in case of hurricanes, net or cage failure, or a pollution event. This plan is necessary to prevent or minimize environmental damage from dislodged equipment, escaped fish, or degradation of water quality.

Alternative 3(c) would require aquaculture operations to comply with conditions designed to aid law enforcement officials, which would provide law enforcement the tools needed to help prevent poaching and the sale of illegal wild caught fish mixed in with cultured product. **Alternative 3(d)** would be a use it or lose it provision designed to eliminate speculative permitting requests. This would prevent a permit applicant from securing an aquaculture site with the intent of selling or leasing that site at a cost to an aquaculture facility. This provision would increase the chance of a fair and equitable allocation of resources (National Standard 4). **Alternative 3(e)** would require other information to aid in enforcement and monitoring, and **Alternative 3(f)** would authorize the NOAA Fisheries Service RA to specify additional permit conditions, as necessary, for issuance and administration of an aquaculture permit.

Summary Comparison of Physical, Biological, and Ecological Consequences

The alternatives specified in this section create (or do not create) conditions which must be met by an aquaculture facility. **Alternative 1** does not specify any permit conditions and would therefore have the most potential for causing negative effects on the physical, biological, and ecological environment. Not creating a set of conditions, which must be adhered to, would allow facilities to engage in activities that may be detrimental to the physical, biological, and ecological environment. **Alternative 2** maintains the use of the conditions specified for an EFP. These conditions, however, are subject to change over time and even from one permit to another because of the lack of specificity provided in the EFP regulations, and therefore may not afford adequate protection to the physical, biological, and ecological environments. **Preferred Alternative 3**, in contrast, sets forth specific conditions intended to prevent or minimize impacts on the physical, biological, and ecological environments. These conditions, and the recordkeeping and reporting requirements in Action 4.8 are intended to ensure the operations of all offshore aquaculture facilities permitted in the Gulf of Mexico are consistent with the MSFCMA National Standards (Section 6.10) and do not compromise Council objectives for wild fisheries.

Preferred Alternative 3(a), which requires an assurance bond as a condition of permit issuance, is designed to reduce or eliminate impacts on the ecological environment and navigation. Facilities that terminate operations may not be able to afford the costs of removing aquaculture structures from the water due to economic or other considerations. This would leave equipment in the water, which over time may degrade the surrounding environment, cause hazards to navigation, and result in entanglements of wildlife. If a structure is displaced because of a storm, essential fish habitat could be potentially damaged by the structure. The assurance bond would provide funding to facilitate the removal of abandoned structures and therefore, would reduce the long-term impacts that may result if the structure remained in the water. Similar to this condition is the condition requiring an emergency disaster plan for hurricanes, net or cage failure and subsequent escapement, or a pollution event. As a sound business practice with millions of dollars invested, most of these contingency plans will most likely be in place voluntarily. The loss of fish, equipment, and pollution to the environment all result in or could potentially result in the loss of profit to an aquaculture facility. The plan, however, will help NOAA Fisheries Service (or other agencies) to assess the adequacy of the plan and aid in strengthening that plan if it is deemed necessary to do so; additionally, an agreed upon plan may allow agencies to assist during a disaster to help ensure the event is recovered from with the least amount of impact to the environment.

Preferred Alternative 3(b)i is intended to prevent genetic impacts on wild Gulf stocks by ensuring the integrity of wild populations is maintained in the event fish were to escape from an aquaculture facility. By requiring information on the source of broodstock or fingerlings and requiring that source to be the same as the wild populations found in the geographic region a facility is sited, it can be assured that any individuals that escapes would have the same genetic makeup as their wild counter parts and, therefore, not alter the genetic diversity of the localized population. Additionally, the preferred alternative in Action 4 would require only native, non-transgenic species be

used for aquaculture, providing further safeguards to wild stocks in the event of escapement.

Preferred Alternative 3(b)ii, would require an aquatic health management plan. This plan would require an aquaculture operation to have an animal health expert. The plan would also need to specify procedures for containing disease outbreaks. This requirement will benefit both the operation, which due to economic reasons wants to avoid disease outbreak, and wild populations to which the disease may be transmitted if left unchecked. By using an aquatic animal health expert, disease outbreaks will be identified quickly and measures to halt the spread of disease and to cure those individuals affected can be implemented.

Preferred Alternative 3(b)iii would require an operation to describe their plan for collecting broodstock and rearing fingerlings. Similar to **Preferred Alternative 3(b)ii** this plan is designed to minimize impacts on wild populations and prevent disease outbreaks. A plan describing the hatchery facility and the number and types of fish to be used will allow for an assessment of facility operations. A description of procedures for collecting broodstock and rearing fingerlings will allow NOAA Fisheries Service to assess if broodstock are being collected from the appropriate geographic region and being exchanged on a regular basis (25 percent per year).

Preferred Alternative 3(b)iv would require an operation to describe their plan for conducting environmental monitoring. Conditions requiring environmental monitoring are designed to detect any adverse affects from a facilities operation to both the biological environment as well as the physical environment. These conditions will require a facility to follow requirements set forth by NOAA Fisheries Service (e.g., ESA) and the EPA. Section 5.2.3.3 lists species in the Gulf of Mexico protected under the MMPA and ESA and the potential actions to determine the impact of aquaculture on these species. This will assure that biological diversity and integrity is maintained as well as maintaining good water quality in the area surrounding a facility.

Preferred Alternative 3(b)v would require an operation to have an emergency disaster plan in case of hurricanes, net or cage failure, or pollution events. During hurricanes nets, cages, and other equipment can become dislodged and moved from the site of the operation. This equipment could then cause damage to the benthic environment, or create navigational hazards. Net or cage failure could allow a large number of cultured species to escape. This would result in the introduction of cultured fish into wild populations. As required by Action 4, cultured fish would have to be native to the Gulf and not genetically modified, thereby mitigating negative effects associated with accidental escape. Conversely, net or cage failure could allow wild organisms to enter into the net or cage resulting in entanglement or capture. Regular maintenance of the cage or net and rapid repair of equipment would reduce the potential impacts of such damage. Pollution events could be due to entities outside the operation or due to the operation itself. If due to the operation, spills of chemicals such as fuel or hydraulic fluid could directly impact water quality, or spills of feed could create eutrophication which would also impact water quality in the immediate vicinity surrounding an operation. A

major decrease in water quality could lead to disease outbreaks and increases in mortality of both wild and cultured organisms.

Preferred Alternative 3(c) would provide law enforcement the tools needed to help prevent poaching and the sale of illegal wild caught fish mixed in with cultured product. These tools help ensure the mission of protecting and conserving the resources of the Gulf can be accomplished by closing loopholes that may be created through development of an aquaculture industry.

Preferred Alternative 3(d) is intended to eliminate speculative permitting attempts. There has been some concern expressed about companies or individuals applying for permits merely to secure the "rights" to a given site and then attempting to sell or lease that site at a cost to an aquaculture company. This could be possible if a company or person were to identify the best areas for aquaculture facilities to be sited and then secure permits for those sites with no intent to conduct aquaculture operations at these sites. This alternative is entirely for administrative purposes and would have no effect on the physical and biological environments.

Preferred Alternative 3(e) would require additional information and actions to aid law enforcement. Some requirements provide specific information on who is involved in an aquaculture operation (i), where the operation is located (ii, iii), and what equipment will be used (iv). Many of the requirements help law enforcement in distinguishing vessels involved in aquaculture operations from commercial vessels (v-ix). They also prohibit filleting fish at sea (vii). These requirements are important for protecting the wild resources of the Gulf by reducing the chance for illegal harvest.

Preferred Alternative 3(f) would provide the NOAA Fisheries Service RA with authority to specify other appropriate permit conditions, as deemed necessary, for issuance and administration of an aquaculture permit. This provides additional flexibility for specifying permit conditions to protect the physical and biological environments that may have been overlooked by the Council during development of this amendment.

Summary Comparison of Socioeconomic and Administrative Consequences

NOAA Fisheries Service is considering specific requirements to qualify for a permit. These requirements generally fall into two categories: (a) an assurance bond to guarantee removal of structures when the permit expires and (b) information potential investors would need to provide to NOAA Fisheries Service prior to receiving a permit.

The types of permits that would be issued under **Action 1** impact permit requirements in **Action 3.** Selecting Action 1 (**Alternative 1**) along with either Action 3 (**Alternative 1**) or Action 3 (**Alternative 2**) will have the same result. An EFP will be required to operate the aquaculture facility and the permit requirements associated with obtaining an EFP must be met (see **Alternative 2**). However, if either Action 1 (**Alternative 2** or **Alternative 3**) is selected with Action 3 (**Alternative 1**), NOAA Fisheries Service could require more or less information than is required under the EFP process (note: portions of the EFP process are proposed to be modified).

In general, one can conclude that the costs to potential offshore aquaculture business ventures under **Alternative 1** will equal the EFP requirements under Action 1 (**Alternative 1**). Without specifying the permit requirements associated with Action 1 (**Alternative 2** or **Alternative 3**), the information needed to monitor the industry could not be collected by NOAA Fisheries Service. They would likely require only the minimum information necessary to issue a permit. Private and administrative costs associated with **Alternative 1** would be minimized because no permit conditions would be specified or need to be reviewed. However, if sufficient information is not collected to properly monitor the industry; public costs could be large in terms of environmental impacts or costs to remove structures from the EEZ.

As specified at 50 CFR 600.745(b) (3) (v):

> The Regional Administrator or Director may attach terms and conditions to the EFP consistent with the purpose of the exempted fishing, including, but not limited to: (A) The maximum amount of each regulated species that can be harvested and landed during the term of the EFP, (B) The number, size(s), name(s), and identification number(s) of the vessel(s) authorized to conduct fishing activities under the EFP. (C) The time(s) and places where exempted fishing may be conducted. (D) The type, size, and amount of gear that may be used by each vessel operated under the EFP. (E) The condition that observers, a vessel monitoring system, or other electronic equipment be carried on board vessels operated under an EFP, and any necessary conditions, such as predeployment notification requirements. (F) Reasonable data reporting requirements. (G) Other conditions as may be necessary to assure compliance with the purposes of the EFP, consistent with the objectives of the FMP and other applicable law. (H) Provisions for public release of data obtained under the EFP that are consistent with NOAA confidentiality of statistics procedures at (*sic*) set out in subpart E. An applicant may be required to waive the right to confidentiality of information gathered while conducting exempted fishing as a condition of an EFP (Appendix A).

Information requirements under **Alternative 2** give NOAA Fisheries Service considerable latitude regarding what information it can request from the applicants. To protect the marine environment and to facilitate enforcement, one would expect that "reasonable data requirements" requested by the RA or his designee would closely "mirror" those stated in **Preferred Alternative 3(b)** of this Action[3]. Hence, with some minor distinctions (discussed in association with **Preferred Alternative 3(b)**), one would expect little differences in the discussion of benefits and costs associated with **Alternative 2** and **Preferred Alternative 3(b)**.

3 As discussed below, all information requirements associated with Alternative 3(b) appear "reasonable."

Preferred Alternative 3(a) would require an assurance bond as a condition of permit issuance[4]. These costs need to be compared to the benefits of removal. The benefits represent the reduction in external costs to society. One of the larger benefits may relate to safety considerations of vessels shrimping or traversing through the area. It is difficult to either qualitatively or quantitatively estimate these costs. Regardless, whether the benefits of removing the offshore structures exceed the costs, there may be other compelling reasons for removing them when operations terminate or are damaged. Requiring an assurance bond prior to initiation of offshore operations forces the firm to treat removal costs as an additional upfront cost. If the firm terminates operation and leaves without removing the structure, the funds have already been provided to the government for the removal process.

Several conclusions can be drawn regarding requiring assurance bonds. First, there is insufficient information to determine whether the National Net Benefits would be enhanced by requiring removal of offshore structures when operations terminate[5]. Second, costs to society are unaffected by who removes the structures (government or the business venture). Third, there may be more cost-effective manners for ensuring safety after aquaculture operations are terminated. And finally, one can conclude that any assurance bond requirement may reduce investment.

Preferred Alternative 3(b)[6] would require those investors seeking an offshore aquaculture permit to provide NOAA Fisheries Service with a set of plans for addressing or monitoring certain environmental conditions so that adverse conditions can be prevented. All items listed in **Preferred Alternatives 3(b)i-iv** will have been considered and included in any "good" business plan. Hence, the cost of providing this information to NOAA Fisheries Service will only be the cost of summarizing information already obtained or developed by the firm.

The benefits to society of NOAA Fisheries Service having this information are large. First, it will allow NOAA Fisheries Service to more fully assess the potential impacts of the proposed facility on the surrounding environment. Second, it will help to ensure that the facility has the appropriate measures in place should any problems arise. Third, it will facilitate enforcement associated with the proposed activities. Finally, assuming the information provided to NOAA Fisheries Service is not proprietary in nature, members of

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4 In the absence of the passage of the National Offshore Aquaculture Act of 2007, there is some question whether the NMFS would legally be able to require this bond. Certainly, costs of removal of the structures goes well beyond recovering administrative costs.

5 If they are not removed, however, then one must consider the external cost associated with not removing them (i.e, the external costs to society after aquaculture operations have ceased) in the efficient duration length. If external costs after operations cease are relatively high, one might reach the conclusion that the costs to society of offshore aquaculture exceed the benefits.

6 Note that if Action 1, Alternative 2 is selected as the preferred alternative, then the information requested under Action 3, Alternative 3(b) may be incompatible with the preferred alternative selected under Action 1. Since the phrase "reasonable data requirement" is included in 50 CFR 600.745(b)(3)(v), however, one cannot necessarily conclude that they are incompatible.

the public will be able to obtain valuable information to make more informed judgments regarding benefits and costs of the proposed facility.

The benefits associated with **Preferred Alternative 3(b)** far exceed those of **Alternative 1**, which would not establish permit conditions. One could anticipate that information requirements specified in **Alternative 2** would mirror those in **Preferred Alternative 3(b)**. However, requirements for **Alternative 2** would have to be explicitly specified by the NOAA Fisheries Service RA.

The intent of the elements in **Preferred Alternative 3(c)** is to improve law enforcement's ability to monitor offshore aquaculture production. **Preferred Alternative 3(c)(1)** would require any vessel used in the aquaculture operation to have an aquaculture permit on board the vessel. Requiring the permit to be onboard allows enforcement personal to identify harvest and/or supplies onboard the vessel. Linking the vessel with a specific firm should enable the enforcement officers to more easily determine whether the vessel is in compliance with both aquaculture and wild stock harvest requirements. Simplifying the process to link the activities of a vessel with aquaculture activities should reduce overall enforcement costs, while only increasing the cost to the firm by an amount required to obtain a copy of the permit and store it on the vessel.

Preferred Alternative 3(c)(2) would require the aquaculture firm notify law enforcement of the time, date, and port of landing at least 3 hours prior to landing. The advance provides enforcement staff with a warning that a landing is eminent and allows staff to target specific vessels for data-gathering and enforcement needs. Implementing this requirement would improve enforcement's ability to effectively observe offloads and gather biological data from specific vessels. If operators did not provide a location of landing it may be difficult for enforcement staff to observe landings and offloads. Limiting the notice time to only 3 hours should provide aquaculture operators sufficient time to plan their harvests and notify enforcement of when and where the landing will occur.

This alternative does not specify a window when landings could occur. Limiting the hours when landings could occur reduces the need to have additional enforcement agents during other hours, reducing the enforcement costs associated with the program. Not limiting the landings hours will provide additional flexibility to the aquaculture firms. It may also allow them to time landings to meet the requirements of various fresh markets. If the longer offload window does provide marketing advantages, it would likely increase the ex-vessel price of the fish they are selling by improving market efficiencies that are likely to have an overall beneficial effect on consumers. These benefits are not amenable to further quantification, at present, given available information on costs, earnings, and operational structure within the respective segments of the industry.

Preferred Alternative 3(c)(3) would require that the aquaculture business maintain a record of the number of fingerlings placed in the facility. By knowing the number of fingerlings that are being raised enforcement could determine whether too many fish are

being harvested. Records on the number of fish being raised will provide another mechanism that enforcement could use to track the number of fish a firm should be allowed to harvest from their facility.

The costs incurred by the aquaculture firm to comply with this requirement should be very small. If the firm purchases their fingerlings they will have sale receipts that document the number of fingerlings they purchased. Firms raising their own fingerlings, would likely count the fingerlings when pens are stocked. Determining the number of fingerlings stocked per pen would likely occur to ensure that the pens are stocked to the proper density to maximize production from the facility. The overall cost of storing the information in either case would be the time and filing supplies to maintain the data. For a six-cage system, these costs[7] should not amount to more than $20 per stocking of the cages.

Preferred Alternative 3(c)(4) requires the submission of fin clips from broodstock used in spawning of fingerlings. Enforcement could use the fin clips to obtain DNA or other material to link the broodstock to the fish being raised at the facility. Those links would provide another enforcement measure to ensure that only fish from the aquaculture facility are being harvested and marketed by the firm.

This alternative does not provide information on the specific methods that must be followed when supplying the fin clips. Standard biological procedures will likely be developed by NOAA Fisheries Service for submitting fin clips to enforcement. Kits that are used to store DNA are available from various suppliers over the internet for less than $20. DNA kits proposed to be used by law enforcement offices in Maryland under Senate Bill 486 proposed in 2002 cost $3.50 each (http://mgadls.state.md.us/PDF-Documents/2002rs/fnotes/bil_0006/sb0486.PDF). The cost to store 100 samples for a year was $50 (http://www.analyticalgenetics.ca/pricelist.php). These cost estimates were provided to indicate the costs of fin sample collection. For example, if four animals were needed for broodstock by a firm, the total cost of complying with this requirement could be less than $40 a year ($10 per animal) for materials, time, and transportation to the proper office. The cost to the government to store the samples could be about $50 per year per 100 broodstock.

Preferred Alternative 3(d) defines a use it or lose it provision for the aquaculture site. An offshore aquaculture permit, which grants a person the privilege to use a specified site for an aquaculture operation can be considered a tangible asset. In a private market setting, the price of a tangible asset (either sales price or lease price arrangement) will be directly related to its contribution to the output process (i.e., its marginal value product). If sold (leased) within a private market setting, therefore, the price that one would be willing to pay for a permit would relate to its ability to generate profits at other permitted sites.

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7 The cost of six file folders (one per cage), space in a file cabinet, and the time to file the folders. Alternatively the information could be stored on a computer and the overall cost would be even lower.

Since the maximum amount that can be charged for a permit under the Magnuson Stevens Act, however, is limited to administrative costs associated with issuing the permit, one can envision applications for permits in excess of that number intended for near-term use. There are at least three reasons for this. First, an individual/group may apply for a permit with the anticipation of developing an offshore aquaculture operation at some (distant) future point in time (say, after sufficient capital is raised). While there may be benefits to such an action, such actions are likely to be excessive from an economic perspective because the cost of the permit is below its potential contribution to the production process. Furthermore, such an action may displace potential operations that have the required capital and can begin to produce output within a limited period of time.

The second reason why the number of applications may exceed the number intended for near-term use, in the absence of a use it or lose it provision, reflects speculative activities among investors. Specifically, while this amendment does not include a provision for the transfer of permits, some investors may apply for a permit under the premise that the amendment may, at some future point in time, be amended to allow for transfer of permits. At such a point in time, the speculator can, through the sale of the permit, earn the difference between what he is able to sell the permit for (i.e., the marginal value product of the permitted site) and what he paid for the permit (i.e., the application cost).

A final reason why the number of applications may exceed the number intended for near-term use, in the absence of a use it or lose it provision, reflects the fact that some individual/groups may simply be opposed to offshore aquaculture operations and, as such, apply for permits with no intention of using these permits for commercial offshore aquaculture. Rather, the purpose of applying for the permits is to exclude those with the intent of establishing offshore aquaculture facilities from doing so in desired locations (i.e., those locations that would be most conducive to offshore aquaculture operations).

Given the expected positive net national benefits associated with offshore aquaculture, one can conclude that actions limiting the ability of interested entrepreneurs from establishing operations in the near term will result in a reduction in net benefits. Hence, a provision that requires development of operations within two years of issuance of a permit is likely to provide positive benefits to society.

Preferred Alternative 3(e) would provide for additional permit conditions. The only options that would increase the costs beyond the typical paperwork requirements are **Preferred Alternatives 3(e)(iii)** and **3(e)(vii). Preferred Alternative 3(e)(iii)** requires that at least one locating device must be attached to a cage or pen. The type and cost of the pen-locating device that would be used by each firm, while not known with certainty, is likely to range from $350 to $1,450 per buoy.

Preferred Alternatives 3(e)(iv) and **3(e)(v)** would merely require a description of the types of harvesting equipment being used for harvesting the cultured product and conditions under which the aquaculture harvesting gear (or other fishing equipment) will be deployed. The costs of providing this information to NOAA Fisheries Service would

be negligible yet this information can be used by enforcement to monitor harvesting operations in a cost-effective manner.

The intent associated with requirement specified under **Preferred Alternatives 3(e)(i) 3(e)(vi), 3(e)(viii),** and **3(e)(ix)** is to provide enforcement with information needed to better manage both offshore aquaculture industry and its interaction with the capture industry. **Alternative 3(e)(i)** would require the applicant to submit information pertaining to vessels being used in an aquaculture operation (e.g., names of captains and vessel owner, project vessel). Provision of this information will entail little cost to the firm yet enforcement can use it to ensure that operations being conducted by the vessel are consistent with aquaculture regulations. **Preferred Alternative 3(e)(xi)** would require the permittee to notify NOAA Fisheries Service prior to the removal of aquaculture fish from facility to shore. The cost of providing this information would be negligible yet the information will assist enforcement personnel in ensuring that wild harvest is not being commingled with (or substituted for) cultured product[8]. Similarly, prohibition of the possession of wild fish aboard any marine aquaculture facility, and its transport and service vessels, vehicle, or aircraft (i.e., **Preferred Alternative 3(e)(ix))** will help to deter commingling or substitution of wild product with cultured product. Costs associated with this alternative will be negligible.

Preferred Alternative 3(f) would merely allow the NOAA Fisheries Service RA to impose conditions in addition to those already specified, as deemed appropriate. Without additional information pertaining to what these conditions might be, it is impossible to determine whether this alternative would result in any significant increase in costs. Likewise, benefits are unknown.

With regard to the administrative environment, **Alternative 1** would not require any conditions to be met or maintained by an aquaculture facility. This would limit the oversight to administrators of an aquaculture facility's operations, which would in the long-term, require more effort from administrators to be sure that a facility was operating in the intended manner of this amendment. **Alternative 2** would maintain the status quo of using conditions specified in an EFP. The continued use of this approach to aquaculture is not expected to allow an offshore aquaculture industry to develop and is, therefore, not the intent of this amendment. Additionally, the variation seen from one EFP application to another makes it burdensome on administrators in assessing a facilities operations and its potential impact on the various environments. **Preferred Alternative 3** would create a set of conditions, which would provide the necessary information to administrators, thereby allowing them to more efficiently and consistently evaluate permits. Therefore, **Preferred Alternative 3** would benefit the administrative environment more than either **Alternative 1 or 2**.

4.4 Action 4: Species Allowed for Aquaculture

Alternative 1: No Action, do not specify species for aquaculture.

8 It also provides a timeframe from which enforcement can conduct inspection activities.

Alternative 2: Allow the aquaculture of all non-genetically modified Gulf of Mexico finfish species in the reef fish, red drum, and coastal migratory pelagics FMPs.

Alternative 3: Allow the aquaculture of all non-genetically modified marine species in the Gulf of Mexico managed by the Council except those species in the shrimp and coral[9] fishery management plans. Harvest or possession of goliath grouper and Nassau grouper is prohibited in the Gulf EEZ.

Preferred Alternative 4: Allow the aquaculture of all marine species in the Gulf of Mexico managed by the Council, except those species in the shrimp and coral[9] fishery management plans, and send a letter to NOAA Fisheries Service requesting development of concurrent rulemaking to allow aquaculture of highly migratory species. Do not allow non-native species, transgenic species, or otherwise genetically modified species to be used for aquaculture in the Gulf of Mexico.

Discussion and Rationale

Action 4 considers species that would be allowed for aquaculture in the Gulf of Mexico. Alternatives range from prohibiting culture of species not native to the Gulf to allowing only the culture of finfish to prohibiting shrimp, corals, and some species for which commercial and recreational harvest are prohibited. The action and proposed alternatives would not affect the aquaculture of live rock, which will continue to be regulated by management measures approved by the Gulf and South Atlantic Councils in Amendments 2 and 3 to the Coral and Coral Reefs FMP.

Alternative 1, the no action alternative, would not specify which species would be allowed for aquaculture. If **Alternative 1** were chosen, a permit applicant could request permission to culture any species, whether or not it was native to the Gulf of Mexico, managed by the Council, vertebrate or invertebrate, or already protected from fishing in the Gulf of Mexico EEZ. NOAA Fisheries Service would then determine whether culture of a particular species was acceptable, rather than the Council making that determination preemptively. Under **Alternative 1**, NOAA Fisheries Service could determine if culture of a particular species was acceptable including non-native species. However, such approval is unlikely because many groups oppose such introductions. Further, The Gulf Council's Ad Hoc Aquaculture Advisory Panel has also indicated opposition to the use of any non-native species for aquaculture.

Alternatives 2 and **3** and **Preferred Alternative 4** would limit culture to species managed by the Council that have not been genetically modified. **Alternative 2** would further limit culture to only managed finfish, while **Alternative 3** would allow culture of

9 Live rock will continue to be regulated by management measures approved in Amendments 2 and 3 to the Coral and Coral Reefs FMP.

Council managed finfish and invertebrates, but would prohibit culture of goliath and Nassau grouper. **Preferred Alternative 4** would allow culture of all species native to the Gulf of Mexico and includes a request to NOAA Fisheries Service to develop concurrent regulations to allow aquaculture of highly migratory species.

There is some evidence of the detrimental effects of non-native species on ecosystems. If non-native species were allowed to be cultured in the Gulf of Mexico EEZ and some escaped, it could have negative impacts on the biological, physical, and ecological environments (see discussion in section 6.1). Potential negative effects caused by the introduction of non-native species include: competition with wild stocks, changes to community structure and food web dynamics, and modification of genetic structure. In the most extreme cases in which non-native species become established, fundamental changes in ecosystem function may result in habitat degradation, transmission of disease, and loss of other species. Allowing only species native to the Gulf of Mexico and managed by the Council will ensure that any species being cultured are under an FMP and managed according to the National Standards, including National Standard 3 which requires that a stock be managed as a unit throughout its range, to the extent practicable.

From the perspective of aquaculture companies, **Alternative 1** would be the least restrictive and allow culture of any species if NOAA Fisheries Service approved it. **Preferred Alternative 4** would be the second least restrictive as it would only prohibit culture of genetically modified, non-native species, shrimp, and corals. **Alternative 2** would allow aquaculture of all finfish managed by the Council. These species are likely to include all or most of those selected by the aquaculture industry initially for culture in the Gulf of Mexico (see discussion in Section 2.2). Red drum, cobia, and mutton snapper have already been cultured successfully. Many of the species in the Council's Reef Fish FMU have been successfully spawned in captivity; therefore fingerlings of these species could be produced for commercial culture. **Alternative 3** would allow culture of all species managed by the Council except shrimp and coral (see Appendix F for a list of all species included in the Council's FMPs). Spiny lobster and stone crab stocks are prohibited from being cultured under **Alternative 2**.

Given the domestic and international aspects of fisheries for Atlantic highly migratory species (HMS), including tunas, swordfish, sharks, and billfish, these fisheries are managed under the dual statutory authorities of the Magnuson-Stevens Fishery Conservation and Management Act and the Atlantic Tunas Convention Act. The Fishery Conservation Amendments of 1990 (Public Law 101-627), vested managerial authority for Atlantic HMS in the U.S. Exclusive Economic Zone with the Secretary of Commerce. Acknowledging this management structure, as well as the interest and expertise of the Council on aquaculture issues, the Council is requesting NOAA Fisheries Service develop concurrent rulemaking pertaining to aquaculture activities for Atlantic HMS in the Gulf of Mexico.

Preferred Alternative 4 would allow for culture of all managed species listed in Appendix F, except corals and shrimp. Species overfished or undergoing overfishing would be allowed to be cultured. As such, culture of these species would increase

optimum yield for those stocks and may reduce fishing mortality consistent with National Standard 1.

Summary Comparison of Physical, Biological, and Ecological Consequences

An indirect effect of culturing native fishes is the potential harvest of broodstock or young fish of the target species for use in aquaculture. Harvest of native wild fish to support aquaculture activities could have negative indirect effects on the biological, physical, and ecological environments. The extent of these negative effects would depend on whether cultured fish were produced by breeding wild parents, in which case only a few wild fish would be needed, or whether wild fish were captured and then grown to market size, in which case many young fish could be harvested. If few fish are caught and used as broodstock, then little, if any, negative effect on the wild stock would occur. Any harvest of wild stocks would be subject to the regulations under the MSFCMA.

Introduction of non-native species through aquaculture could cause negative effects to the physical, biological, and ecological environments. Allowing the culture of non-native species by NOAA Fisheries Service is unlikely, however, because the intent of this amendment is to allow the culture of species managed in the Council's FMPs and those regulated in the HMS division of NOAA Fisheries Service. Additionally, the U.S. Fish and Wildlife Service and NOAA co-chair a federal Aquatic Nuisance Species Task Force that oversees a program to prevent the introduction of, monitor, control and study aquatic nuisance species, which suggests that both agencies would advocate a precautionary approach to any introduction of non-native species. The more realistic threat to native species is the currently unforeseen consequences of harvest of young, small fish or invertebrates for use in aquaculture growout facilities. Again, this is not likely to have a negative impact however because any harvest of species for growout would be subject to the authority of the MSFCMA. Additionally, it is assumed most facilities will only harvest a limited number of individuals to be used as broodstock to spawn fingerlings for growout, since this is more efficient than harvesting fingerlings from wild stock.

Harvest of some species (Nassau grouper, goliath grouper, red drum, corals) is prohibited in the Gulf EEZ. If a legitimate "cultured" source of these species developed, it could provide a means to sell illegally harvested fish, by marking them as "cultured." **Alternative 3** would prohibit culture of goliath and Nassau grouper. **Alternative 2** would prohibit culture of corals. **Alternative 1** would not prevent poaching because it would allow culture of all these species, while **Preferred Alternative 4** would allow culture of Nassau and goliath grouper and red drum and prohibit the culture of corals. Poaching of any of these species would negatively impact the biological and ecological environments by increasing fishing mortality on these species. In turn, under the most extreme case this could lead to overfishing and threaten a stock's sustainability. However, recent developments in forensic methodology would allow law enforcement to analyze the origin of individuals to determine if fish were wild or cultured. Additionally, Action 3 sets forth a set of conditions designed to aid law enforcement in eliminating the potential for poached species to enter the market place.

The other concern with types of species allowed for aquaculture involves the use of genetically modified organisms (GMOs). The Council has made it clear that GMOs will not be allowed for aquaculture purposes in the Gulf's aquaculture industry. Therefore, it is unlikely any alternative will cause negative effects greater than another in the physical, biological, and ecological environments due to the Council's and other agencies restrictions on the use of non-native or GMOs in the aquaculture industry. Instead, the range of alternatives merely provides a range of flexibility for aquaculture facilities in choosing species used for production. **Alternative 1** potentially could have the greatest effect on the physical, biological, and ecological environment of the Gulf by not prohibiting the use of non-native species or GMOs for aquaculture.

Summary Comparison of Socioeconomic and Administrative Consequences

Currently, the only legal avenue for EEZ aquaculture is under an EFP that requires applicants to specify "[t]he species (target and incidental) expected to be harvested under the EFP, the amount(s) of such harvest necessary to conduct the exempted fishing, the arrangements for disposition of all regulated species harvested under the EFP (50 CFR 600.745)." **Alternative 1** could include all species (even non-indigenous species[10]) whether or not they are managed by the Gulf Council and would not preclude genetically modified species.

Of the four alternatives under Action 4, **Alternative 1** is, at least in theory, most inclusive[11]. It includes all species native to the Gulf of Mexico as well as non-indigenous species. For purposes of examining the economic impacts associated with the four alternatives, it is useful to examine alternatives that pertain only to native species (i.e., **Alternatives 2** through **4**) and compare them to the status quo (**Alternative 1**).

To compare **Alternative 3** to **Alternative 2**, the first question that needs to be addressed is whether there is any difference in demand for growing species allowed under **Alternative 3** but not **Alternative 2**. If there is no difference in demand by offshore aquaculture firm operators (current or near future), one can conclude that the benefits and the costs are identical. If there is a demand for a species that cannot be grown under **Alternative 2**, one can assume that entrepreneurs believe that more profits can be earned from **Alternative 3**. In this situation, one can conclude that producer surplus associated with **Alternative 3** could be greater than that associated with **Alternative 2**. It could also

10 This does not imply that non-indigenous species would be allowed in offshore aquaculture since the Regional Administrator, Director, or his designee has latitude on approving the EFP. Also, NOAA and the USFWS co-chair the federal Aquatic Nuisance Species Task Force established to develop a program to prevent, monitor, control and study aquatic nuisance species, which suggests that both agencies would advocate a precautionary approach regarding introduction of non-indigenous species into U.S. waters.
11 The qualifying term "in theory" is used here because permission for the introduction of non-indigenous species would likely not be granted in an EFP. Whether such permission is granted is questionable. The Gulf Council Ad Hoc Aquaculture Advisory Panel is on record of being opposed to the introduction of any non-native species.

be concluded that consumers will benefit (i.e., consumer surplus would be higher with **Alternative 3** than **Alternative 2**)[12].

Preferred Alternative 4, as noted, is more inclusive than **Alternative 3** in that it would allow for aquaculture of all species managed under an FMP, except corals and shrimp, and would request NOAA Fisheries Service to develop concurrent rules for highly migratory species. This option also clearly prevents the introduction of non-native species or transgenic species. The potential biological and environmental costs of introducing those species to the Gulf are thought to outweigh any economic benefits that would be derived from their introduction. Based upon the same line of reasoning used in comparing **Alternative 3** with **Alternative 2**, one can conclude that the Net National Benefits of adopting **Alternative 4** are at least as high as those of adopting **Alternative 3**. Net benefits could possibly be higher if there is demand for entrepreneurs to raise goliath grouper, Nassau grouper, or HMS.

As noted, the status quo, potentially, provides the broadest range of species (i.e., both native and non-native species). Since it could include non-indigenous species, some additional discussion is warranted. Issues/concerns associated with the introduction of non-indigenous species are covered in Section 6.1. While there are additional risks, we as a society take risks every day. The issue with respect to offshore aquaculture is the potential benefits associated with the introduction of non-native species versus the costs. If there is no demand by entrepreneurs for raising these species in the Gulf, then benefits would be zero and costs would be zero[13]. If there is demand, however, there would likely be benefits in the form of increases in consumer and producer surplus. If some of the concerns regarding the introduction of non-indigenous species come to fruition, however, external costs could, potentially, be high. In the absence of any information on the probability of occurrence of a negative environmental impact (e.g., disease, impact of escapement on carrying capacity and wild stocks, etc.) and the costs to society if this impact were to occur, it is impossible to judge whether benefits exceed costs[14]. Hence, it is impossible at this point to compare Net National Benefits under the status quo (**Alternative 1**) with Net National Benefits associated with any of the other alternatives.

The more species allowed for aquaculture, the more potential exists for economic gains. Therefore, the potential for economic benefits is highest for **Alternative 1**, which would not limit the species allowed for aquaculture any more than NOAA Fisheries elected to, followed by **Preferred Alternative 4**, **Alternative 3**, and **Alternative 2**.

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12 See Action 2 for a more complete discussion of expected changes in producer and consumer surplus. As noted in reference to that Action, the reduction in producer surplus in the related capture fisheries is expected to be relatively small given the fact that the current management regimes for Council managed fisheries do not attempt to maximize producer surplus. Hence, it is expected that gains in producer surplus from offshore aquaculture facilities will exceed reductions in producer surplus by the fishing sector. In addition, producer surplus in related sectors (e.g., processing) will likely be enhanced.

13 One might argue that species native to the Gulf, since they are suited to the climate regime, represent candidates that would yield highest profits.

14 One might surmise that USFWS and NMFS would oppose the introduction of any non-indigenous species unless evidence is overwhelming that the risk of introduction is at "an acceptable level."

4.5 Action 5: Allowable Marine Aquaculture Systems

Alternative 1: No Action, do not specify allowable marine aquaculture systems.

Alternative 2: Allow only cages and net pens.

Alternative 3: Allow cages and net pens, and other aquaculture systems, such as systems used for sponges, corals, and bivalve mollusks.

Preferred Alternative 4: To have NOAA Fisheries evaluate each proposed aquaculture system on a case-by-case basis to ensure reliable offshore growing system technology is used to provide environmental safeguards.

Discussion and Rationale

Any aquaculture system must be robust enough to withstand open ocean conditions and prevent fish escapes, and effective in dispersing wastes. The biological, physical, and ecological impacts of the alternatives under consideration differ primarily in the types of systems allowed for aquaculture. Under **Alternatives 2-4**, NOAA Fisheries Service would review each system before permit approval. **Alternative 2** would only allow cages and net pens to be used for aquaculture and **Alternative 3** would allow cages, net pens, and other systems used for invertebrate culture (see Appendix G for illustrations of various aquaculture systems)**.**

Preferred Alternative 4 would not specify allowable systems for aquaculture, but would provide NOAA Fisheries Service the authority to evaluate each proposed system on a case-by-case basis. The purpose of this alternative is to allow NOAA Fisheries Service to review each system to ensure maximum environmental safeguards are being used while at the same time allowing operations to use the most recent technology developed for aquaculture systems (National Standard 6). Additionally, under **Preferred Alternative 4**, systems would be evaluated for efficiency, economy, and safety (National Standards 5, 7, and 10). If, however, an applicant proposed a system outside the scope of this amendment, then additional environmental analyses may be required before approval of such a system.

Summary Comparison of Physical, Biological, and Ecological Consequences

The alternatives under consideration differ in the extent to which they limit use of invertebrate culture systems or novel fish culture systems. Those that limit use of such systems could have negative effects on biological, ecological, socioeconomic, and administrative environments. Neither **Alternative 2** nor **Alternative 3** would allow use of future aquaculture system designs, which do not meet the definition of a cage or net pen. Such future designs may cause less negative impacts to the biological, physical, or ecological environments than current designs. A prohibition against using such designs would result in more such negative effects unless the Council amended the list of

allowable marine aquaculture systems. In addition to prohibiting such future fish culture systems, **Alternative 2** would prohibit use of systems designed to culture invertebrates, leading to missed opportunities for aquaculture companies to both: 1) earn money from culturing these species and 2) explore use of filter-feeding invertebrates and nutrient-utilizing plants to cheaply improve the water quality near fish culture systems. Choice of **Alternative 2** would also forego an opportunity to reduce negative impacts to the biological, ecological, and physical environments by using invertebrates and/or plants to process waste from cultured animals.

Alternative 3 would allow invertebrate growout systems in addition to net pens and cages. If **Alternative 2** or **Alternative 3** were chosen, the Council would need to amend the Generic Aquaculture Amendment in the future to allow the use newly invented marine aquaculture systems that are not currently specified in these alternatives. The administrative costs associated with development of such an amendment would be saved if **Alternative 1** or **Preferred Alternative 4** were chosen in this amendment, although additional amendments or NEPA analyses may be required if a system falls outside the scope of this amendment.

Alternative 1 would not prohibit a particular aquaculture system design. **Preferred Alternative 4** would not prohibit a particular design as long as a review by NOAA Fisheries Service found a proposed system to be reliable and environmentally sound. Factors that could be used to determine the reliability of a system may include, but are not limited to:

1) Potential for habitat degradation;
2) Types of materials comprising the system;
3) Efficiency of mechanisms used for feeding;
4) Ability of the system to disperse wastes; and,
5) Accessibility of system for maintenance and repair.

Because **Preferred Alternative 4** would require NOAA Fisheries Service review, it would allow unreliable systems to be disapproved that may otherwise have been used if **Alternative 1** is selected. Unlike the other two alternatives, **Alternative 1** and **Preferred Alternative 4** would both allow use of yet-to-be invented fish aquaculture systems.

Alternatives 2 and 3 would not require NOAA Fisheries Service to review a cage or net pen design before it was deployed. **Preferred Alternative 4** would require such a review. The alternatives in order from least likely to most likely to adversely affect the physical, biological, and ecological environments due to lack of detection of a faulty marine aquaculture design are as follows: **Preferred Alternative 4**, **Alternative 2**, **Alternative 3,** and **Alternative 1**. The alternatives in order from least likely to most likely to adversely affect the physical, biological, and ecological environments due to lack of use of innovative new fish culture system designs and lack of use of plants and invertebrates to break down fish waste are as follows: **Preferred Alternative 4**, **Alternative 1**, **Alternative 3**, and **Alternative 2**. Therefore, the more restrictive the

review process is for approving aquaculture systems, coupled with the flexibility of allowing a diverse array of gear types, the less potential for negative effects on the physical, biological, and ecological environments.

Summary Comparison of Socioeconomic and Administrative Consequences

Action 5 consists of four alternatives. **Alternative 2** would allow only cages and net pens in offshore aquaculture, while **Alternative 3** would allow cages, net pens, and other invertebrate growout systems. **Alternative 1** is the most flexible in that no restrictions would be placed on the type of aquaculture system that would be allowed. **Preferred Alternative 4** is the Council's preferred alternative. It does not restrict the types of aquaculture systems that may be used, but would require NOAA Fisheries Service to explicitly review each application to ensure that the system provides environmental safeguards.

Currently, the only legal avenue for EEZ aquaculture is under an Exempted Fishing Permit, as provided for under 50 CFR 600.745. Allowable gears (systems) are not specified in the EFP and, hence, the status quo **(i.e., Alternative 1)** is, presumably, equivalent to **Preferred Alternative 4**. Hence, discussion of **Preferred Alternative 4** will serve also for the discussion of the status quo.

Alternative 2 limits the prescribed systems to two types: cages and net pens. **Alternative 3** would, presumably, allow for any system, including systems that are not self-contained. **Alternative 2** would include all systems currently used for finfish culture. **Alternative 2**, however, would preclude certain types of systems that may be feasible for the culture of shellfish species and plant species[15]. **Preferred Alternative 4** is similar to **Alternative 3** in terms of the types of aquaculture systems that may be employed, but explicitly requires NOAA Fisheries Service to review the proposed system to ensure that it provides adequate environmental protections. Therefore, if the applications submitted provide reasonable environmental safeguards, the economic impacts of **Alternative 3** and **Preferred Alternative 4** should be approximately the same.

The expected profits under **Alternatives 3** or **4** would be no less than under **Alternative 2**[16]**.** Any system that can be used under **Alternative 2** may be used under **Alternatives 3** or **4**. Hence, one can conclude that if there is a demand for output that can be grown in a system that would be allowed under **Alternatives 3** or **4** but not **Alternative 2**, then producer surplus would be higher under **Alternatives 3** or **4** than **Alternative 2.** Consumers will also benefit via a reduction in price of those products (assuming a negative own-price flexibility) and prices of related products (assuming a negative cross-price flexibility). Investment could also be enhanced if **Alternatives 3** or **4** are adopted.

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15 Plant species, as defined here, include invertebrates such as sponges.

16 Specifically, if expected profitability from the use of these systems is zero or negative, entrepreneurs will not employ them. In this situation, the implications of adopting Alternative 3 are identical to those associated with Alternative 2.

Those alternatives will also allow more efficient technology advances to be incorporated into business plans.

Net National Benefits under **Alternatives 3** or **4** are expected to exceed those under **Alternative 2** if the following assumptions are met: 1) there is a demand for species that can be grown under **Alternative 3** that can not be grown under **Alternative 2**, 2) such growout systems are profitable, 3) that external costs associated with **Alternative 3** are not significantly higher than those associated with **Alternative 2**, and 4) that administrative costs are not excessive.

Alternatives 2 and **3** would not require NOAA Fisheries Service to review a cage or net pen design before it was deployed. **Alternatives 1** and **4** would require such a review. The alternatives in order from least likely to most likely to adversely affect the socioeconomic and administrative environments due to lack of detection of a faulty marine aquaculture design are as follows: **Preferred Alternative 4**, **Alternative 1**, **Alternative 2**, and **Alternative 3**. The alternatives in order from least likely to most likely to adversely affect the socioeconomic and administrative environments due to lack of use of invertebrate culture, plant culture, and/or innovative new fish culture system design, and a subsequent amendment to this plan to include such systems, are as follows: **Preferred Alternative 4**, **Alternative 1**, **Alternative 3**, and **Alternative 2**.

4.6 Action 6: Designation of Sites or Areas for Aquaculture

Alternative 1: No Action, do not designate areas in the Gulf of Mexico EEZ where aquaculture would be allowed. The Army Corp of Engineers (ACOE) would permit sites for aquaculture. NOAA Fisheries Service and the Council would continue to review and comment on ACOE siting permits.

Alternative 2: Establish marine aquaculture areas. These pre-permitted areas could be used for marine aquaculture and other uses of the area:

a) may be restricted or
b) would not be restricted.

Aquaculture operations would not be limited to these marine aquaculture areas, but pre-permitting areas would allow faster review of applications.

Alternative 3: Establish criteria for siting marine aquaculture facilities (see table 6.7-1 for a list of criteria)

Preferred Alternative 4: Establish general siting criteria to be applied on a case-by-case basis for siting marine aquaculture facilities. Siting criteria would include, but not be limited to the items in Table 6.7-1, and the requirements of ACOE, MMS, EPA, NOAA Fisheries Service,

and other regulatory agencies with authority in the EEZ as applied to aquaculture.

Discussion and Rationale

Action 6 would establish whether broad areas are "pre-authorized" for aquaculture activities or whether criteria would be used to site a marine aquaculture facility. **Alternative 1** would allow NOAA Fisheries Service to evaluate potential aquaculture sites only through commenting on Army Corps of Engineers Section 10 permit applications. However, these applications may not provide all the information NOAA Fisheries Service would need, and would require NOAA Fisheries Service to abide by the Army Corps of Engineers decision. **Alternative 2, Alternative 3,** and **Preferred Alternative 4** would allow NOAA Fisheries Service to conduct its own evaluation of the proposed areas, so there would be little difference in the impacts of these alternatives on the biological, physical, and ecological environments. Criteria would include factors that help determine the location with conditions that are environmentally appropriate (National Standard 5) and that will help to minimize operating costs (National Standard 7). The case-by-case approach of **Preferred Alternative 4** will allow for differences in requirements of the various aquaculture systems that may be approved under Action 5 (National Standard 6).

Summary Comparison of Physical, Biological, and Ecological Consequences

Proper siting of an aquaculture facility is critical to both an operation's success and the protection of the surrounding physical, biological, and ecological environments. Offshore aquaculture is often mentioned as an environmentally safer alternative to inshore or onshore aquaculture because facilities are often sited in deep water with sufficient current flow to disperse wastes. However, if a facility is not properly sited, there is potential for significant environmental impacts to occur. These could range from habitat degradation of surrounding benthos to changes in water quality (e.g., low dissolved oxygen or increased nutrients). To prevent impacts to the biological and physical environments, Action 6 proposes either developing siting criteria for facilities (**Alternative 3** and **Preferred Alternative 4**) or developing pre-authorized areas for marine aquaculture (**Alternative 2**).

Recent environmental monitoring studies conducted off Puerto Rico and New Hampshire indicate benthic and organic loading tends to be fairly localized around open-ocean aquaculture cages (Alston et al. 2005; Rapp 2006; UNH 2006). Alston et al. (2005) conducted bimonthly chemical and macroinvertebrate sampling at a control site and sites 0, 20, and 40 meters away from two cages off the coast of Puerto Rico in 2002 and 2003. There were no significant differences among sampling sites in ammonia-N, nitrate-N, nitrite-N, or phosphate concentrations in the water column, organic matter or organic nitrogen in the sediments, organic nitrogen beneath the cages, organic matter among sampling stations, and total carbon beneath the cages (Alston et al. 2005). Rapp (2006) conducted environmental monitoring in 2004 and 2005 at one of the same cages used in the Alston et al. (2006) study. No organic loading in the benthic water was observed for the first seven months of the study. In the eighth month of the study and thereafter an increase in benthic water organic loading was observed due to a change in the

composition and integrity of the fish feed (Rapp 2006). The study reported no increase in organic loading in the sediment for the duration of the project. Lastly, environmental monitoring off New Hampshire (UNH Marine Aquaculture Center 2006) found no evidence of aquaculture activities affecting water quality parameters (e.g., suspended sediments, chlorophyll, and dissolved oxygen). The study did indicate, however, that marginally significant lower means for total community taxa in impact zones surrounding the cages may be early signs of increased organic loading.

Alternative 1 would maintain status quo regulations and would not provide NOAA Fisheries Service with the authority to site aquaculture facilities. NOAA Fisheries Service would continue to work with the ACOE when providing comments on proposed aquaculture facility sites. **Alternative 1** would not place any further limits on where aquaculture facilities could be located; therefore allowing maximum flexibility for aquaculture companies. The ACOE could potentially approve a site despite NOAA Fisheries Service' objection. Because criteria for approving a site likely will differ between these two agencies, there is potential for a site to be approved that results in negative effects to the biological, physical, and ecological environments.
Such negative effects could include habitat degradation and diminished water quality.

Alternatives 2-4 would provide NOAA Fisheries Service with authority to evaluate a proposed aquaculture site, rather than relying on the review and comment procedures of another agency (**Alternative 1**). This would allow NOAA Fisheries Service to disapprove aquaculture sites proposed for aquaculture, which may have been previously approved by the ACOE. **Alternative 2** would require establishment of pre-authorized aquaculture areas. Such areas would include numerous siting considerations, such as those summarized in Figures 5.1.1.1 to 5.1.3.3-2. A benefit to this approach would include the reduced time for approving a facility's location. However, a negative effect would include establishing areas that may be too large or broad that would not include sufficient detail to prevent or minimize localized, small-scale impacts associated with a particular site.

Alternative 3 would not establish pre-authorized areas for siting, but would require criteria be developed for siting (see Table 6.7.1). Criteria would include such things as water depth, proximity to critical habitat (e.g., MPAs, HAPCs, seagrass beds, etc), water quality considerations (salinity, temperature), navigational hazards, traditionally important fishing areas, etc. (see Table 6.7.1 for additional criterion). Under this alternative, unlike **Preferred Alternative 4**, a predefined range of criteria would need to be established. Each facility would be evaluated based on the same siting criteria providing NOAA Fisheries Service with no flexibility for siting an aquaculture facility. A benefit to this approach would include explicit regulations for siting aquaculture facilities. However, because of the wide-range of habitats that exist in the Gulf, not allowing case-by-case review of sites may hinder the review process and prevent facilities from being sited in areas that otherwise would minimize environmental impacts. Unlike **Alternative 2**, **Alternative 3** would allow small-scale areas to be evaluated in order to reduce potential effects on the localized environment.

Preferred Alternative 4 would allow NOAA Fisheries Service to review proposed aquaculture sites on a case-by-case basis using criteria established by various federal agencies. These criteria would include both specific and general specifications (e.g., do not site facilities where they would be a navigation hazard). These criteria could also establish areas where aquaculture could not occur (e.g., MPAs, HAPCs, other sensitive areas). However, and most importantly, they should site aquaculture facilities in areas where existing regulations established by other agencies (e.g., ACOE) would be met (e.g., lightering zones, shipping channels, and ordinance disposal areas). Reviewing each permit on a case-by-case basis allows for permittees to demonstrate how their system is designed to adhere to these conditions and mitigate negative impacts to these environments. The criteria established in the other alternatives does not allow for administrators to easily adapt to new siting criteria requirements as they arise. However, specifying that criteria of other agencies will be used (**Preferred Alternative 4)** allows administrators to be flexible in applying the regulations of other agencies as they are altered through appropriate rule making. This flexibility would allow the permitting process to be as quick as possible while maintaining the integrity of the environmental protections provided by the various agencies' regulations.

Summary Comparison of Socioeconomic and Administrative Consequences

Maintaining the status quo (**Alternative 1**) will result in no changes in Net National Benefits. The Net National Benefits of the status quo, however, may be smaller or larger than those associated with the other alternatives. Net National Benefits associated with **Alternatives 2**, **3,** and **4** in relation to the status quo are examined below.

This action would create designated areas (zones) or define conditions where offshore aquaculture may occur. There are at least two potential benefits to establishing designated aquaculture areas. First, there is the potential to reduce user conflicts if the designated sites are established in areas outside of areas heavily used in other activities (e.g., commercial or recreational fishing). Second, proper siting of these designated areas can help to ensure ecosystem integrity (e.g., siting in an area that has sufficiently strong current to disperse wastes).

Given that aquaculture operations would not be limited to these marine aquaculture areas, there are few if any direct additional costs (relative to the status quo) to business ventures considering offshore operations (other than a delay in the application review). Likewise, however, additional benefits (relative to the status quo) may be few. Without additional information it is impossible to state that any benefits would be forthcoming from the establishment of these (voluntary) designated areas.

In summary, one cannot conclude that that the Net National Benefits associated with **Alternative 2** are greater than those associated with the status quo (**Alternative 1**). The siting requirements of other agencies (e.g., ACOE) will also determine whether a significant difference in the alternatives exists in reality. If restrictions are placed on other uses in these designated areas, one can conclude that the National Net Benefits associated with **Alternative 2** may be less than those associated with the status quo.

Alternative 2 would create designated areas (zones) or define conditions where offshore aquaculture may occur. There are at least two potential socioeconomic benefits to establishing designated aquaculture areas rather than not establishing them (as in **Alternative 1**). First, there is the potential to reduce user conflicts if the designated sites are established in areas outside of areas heavily used in other activities (e.g., commercial fishing or recreational fishing). Second, the review time for proposed sites located in pre-authorized areas is expected to be less than if such areas are not established (as in **Alternative 1**), benefiting businesses who may lose money if permit approval takes too long.

Alternative 3 potentially provides aquaculture firms with the greatest flexibility and could yield the greatest Net National Benefits. Net benefits would increase if the alternative allows firms to select sites that reduce costs of production (e.g., closer to shore support). Siting criteria will be established that are expected to protect the local habitat around the site. Firms will need to submit applications to NOAA Fisheries Service that define the areas they plan to operate, and those areas must be shown to comply with the defined requirements. Selected locations must also comply with the siting requirements of the Departments of Interior, Defense, and Transportation. The firms may have additional siting costs associated with demonstrating their location meets all requirements. However, given the siting requirements of other agencies, many of those factors would need to be addressed for their siting permits.

The economic impacts of **Preferred Alternative 4** are expected to be similar to those that would result under **Alternative 3**. Neither alternative would establish marine aquaculture areas; instead both would establish general siting criteria that would be used in part to determine whether a site was suitable. **Preferred Alternative 4** does go farther, in terms of defining that applications would be applied on a case-by-case basis to provide environmental safeguards and including other agencies siting requirements. These requirements could slightly reduce net benefits to the aquaculture firms, but those loses could be exceeded by the benefits the Nation receives from tighter environmental control.

The case-by-case review of the siting application could increase the cost and time of the permitting process. Under **Alternative 3**, a permit could be issued if the firm selected an area that met all the general siting criteria. **Preferred Alternative 4** would require that the proposed site and growing technology are compatible to ensure that negative environmental impacts would be minimized. The amount of additional time required to complete that review will depend on the staff available to conduct the review, the number of siting permits that are under review, and level of controversy surrounding whether that site is appropriate. If the site and growing technology are not controversial and NOAA Fisheries Service staff is available to review the proposal, the cost and time to acquire the permit should be similar to **Alternative 3**. However, it possible that a backlog of permit applications on a marginal site proposal could delay approval by days, weeks, or potentially months. The costs of the delay for the applicant would be the increased time to start production and additional costs that could be incurred debating the permit requirements. NOAA Fisheries Service would incur higher costs if more staff time were required to resolve the application approval or denial. However, the increased costs

would not be expected to outweigh the benefits that the Nation would derive from increased environmental safeguards.

Preferred Alternative 4 also explicitly states the siting criteria would include requirements from other agencies that are tasked with overseeing specific activities. The intent of this component is to recognize that other agencies are also involved in the siting process and not to duplicate the requirements of other agencies.

Appendix A in Bridger (2004) provides a summary of work presented by Fletcher and Weston (2004) on the legal and regulatory environment of the offshore aquaculture permitting process. That information is used here to provide a summary of permitting roles of the ACOE, EPA, and MMS.

ACOE permit requirements are a result of the Section 10 of the Rivers and Harbors Act of 1899, as extended by the Outer Continental Shelf Lands Act (OCSLA). A Section 10 permit is required when an obstruction is permanently or temporarily attached to the seabed. The OCSLA extended the ACOE authority into the EEZ by allowing the agency to regulate "installations and other devices permanently attached to the seabed, which may be erected thereon for the purpose of exploring for, developing or producing resources from the outer continental shelf" (Bridger 2004). The ACOE considers several potential impacts before issuing a Section 10 permit. Some of the areas considered are the effects and impacts on water quality, recreation, fish, other wildlife, pollution, safety, aesthetics, navigational integrity, and economic impacts.

The EPA, under Section 318 of the Clean Water Act requires a point source pollution discharge permit for aquaculture projects in the open ocean. Factors considered when reviewing the permit application include the need for proposed dumping and effects on human health and welfare, fisheries resources, plankton, fish, shellfish, wildlife, shorelines, beaches, and the marine ecosystem.

The MMS has jurisdiction, under the Outer Continental Shelf Lands Act, to oversee lease sites that are attached or near an oil or gas platform. MMS requires a permit for platform removal or transfer of ownership. The Energy Policy Act of 2005 gave the Secretary of the Interior authority to issue a lease, easement, or right-of-way on the Outer Continental Shelf for activities that use oil and gas facilities for other (non-energy related) authorized marine-related purposes, such as aquaculture. The MMS published a final Programmatic Environmental Impact Statement in November 2007 which assesses the impacts of allowing the use of energy facilities for non-energy related purposes. The MMS is expected to make a final decision on this action in December 2007.

Because each of the above agencies requires specific information before a permit would be issued, the additional cost of NOAA Fisheries Service requiring similar information would likely be limited to the cost of sending the information to NOAA Fisheries Service. The data would not need to be recreated, so the costs associated with providing the additional data would be the time and copy/printing charges of sending the additional information. If the additional information required 20 pages at $0.10 per page, it would

cost $2.00 plus shipping costs and the time to print and mail the information. A reasonable estimate to assemble, print, and mail the information would be about 10-15 minutes for 20 pages.

Alternatives 3 and **4** would require the applicant to demonstrate their site was consistent with the siting criteria in Table 6.7-1 before a permit was issued. However, the information needed to demonstrate this would likely already be required by other agencies and so the cost of obtaining this information would be the same as for status quo (**Alternative 1**). **Alternative 2** could shorten the amount of time taken to issue a permit, which would be desirable to permit applicants, and could reduce user conflicts and increase social benefits. Overall, the alternatives from the most positive socioeconomic effects to the least positive are **Alternative 3**, **Preferred Alternative 4, Alternative 2**, and **Alternative 1**. Upfront administrative costs from developing guidelines for **Alternatives 3** and **4** would initially be higher than for **Alternative 1**, but would allow for faster evaluation of permits once the amendment was in place. In contrast, **Alternative 2** would require evaluation of large areas for aquaculture up front even if no applicants ever wanted to site a facility in these areas, which would not be an effective use of public resources. Therefore, administrative costs associated with these alternatives, from greatest to least, are as follows: **Alternative 2**, **Preferred Alternative 4**, **Alternative 3**, and **Alternative 1**.

Preferred Alternative 4 and **Alternative 3** potentially provide aquaculture firms with the greatest flexibility and could yield the greatest Net National Benefits compared to **Alternative 1** or **Alternative 2**. Net benefits would increase if the alternative allows firms to select sites that reduce costs of production (e.g., closer to shore support). Firms would be required to choose areas which comply with the requirements defined by NOAA Fisheries Service and any siting requirements of other agencies. The firms may have additional siting costs associated with demonstrating their location meets all requirements. However, given the siting requirements of other agencies, many of those factors would already need to be addressed for their siting permits.

With regard to the administrative environment, **Alternative 2** would require establishment of "aquaculture areas," which would be evaluated before any permit applications are received. If an applicant proposed to place a system in such an area, their permit application would be processed more quickly. This could result in high negative administrative effects from the initial evaluation of large areas and from interactions with applicants when their permit applications were not processed quickly enough. Although **Preferred Alternative 4** and **Alternative 3** would have higher administrative costs than simply commenting on the Corps of Engineers permit, a thorough review of a proposed site would prevent higher administrative costs later from failure of a system. Similarly, establishment of site selection criteria for **Preferred Alternative 4** and **Alternative 3** would take more staff time up front than would **Alternative 1** but not as much as would evaluation of actual proposed areas which may never be used, as required in **Alternative 2**.

4.7 Action 7: Establish buffer zones for marine aquaculture facilities

Preferred Alternative 1: No Action, Do not restrict access around marine aquaculture facilities.

Alternative 2: Create buffer zones for marine aquaculture facilities that within the boundaries of which, fishing and fishing vessels would be prohibited.

Discussion and Rationale

Section 6.8 examines the effects of the various Action 7 alternatives relative to each other within the biological, physical, ecological, economic, social, and administrative environments.

The Council does have authority to create zones that excludes fishing or fishing vessels. Examples are zones where fishing with certain gear is prohibited and no-take zones where fishing and possession of fish is prohibited. Restricting access around aquaculture facilities would afford some protection to an operation's equipment and the product being cultured as well as increasing safety by reducing encounters between vessels and aquaculture equipment (National Standard 10). On the other hand, limiting usage near these sites could be seen as a user conflict by denying the public from accessing these areas. It would also not be the most efficient use of fisheries resources (National Standard 5) because potential fishing areas would not be utilized. The most prudent way to overcome this issue is for an aquaculture facility to request a large enough area to afford protection from potential user conflict problems (e.g. a vessel accidentally cutting a mooring line while passing the facility), while at the same time maximizing other user groups' access to the open ocean.

Summary Comparison of Physical, Biological, and Ecological Consequences

Establishing zones around aquaculture facilities is primarily administrative, but does directly affect the physical, biological, or ecological environment. Restricting access around a facility may directly affect the physical, biological, and ecological environment by protecting species known to aggregate around structure. Aquaculture facilities have been shown as aggregation sites for many wild species. For example, Alston et al. (2006) found species abundance and richness significantly increased around an aquaculture cage off the coast of Puerto Rico after it was deployed. Additionally, the lack of anchoring or any other interactions that may occur (e.g. divers stirring up the bottom) with the physical environment will benefit the benthos of these restricted sites. Also, preventing access around a facility will reduce the likelihood of damage to a facility, and particularly cages and net pens, thereby reducing any potential impacts associated with fish escapement. Overall, **Alternative 2** would benefit the physical, biological, and ecological environment more than **Preferred Alternative 1**.

Summary Comparison of Socioeconomic and Administrative Consequences

This action considers two alternatives. **Preferred Alternative 1** would not restrict access around aquaculture facilities while **Alternative 2** would restrict access. The Council has

the authority to create zones that exclude certain persons or activities (e.g., no-take zones where fishing and possession of fish is prohibited). Creation of buffer zones for aquaculture facilities (**Alternative 2**) may provide some limited benefits to investors; particularly in terms of liability issues and protection of investment. The buffer zones may also facilitate and strengthen enforcement activities (i.e., being inside the buffer zone may provide the presumption of guilt).

The cost associated with creating buffer zones is the potential dislocation of commercial and recreational fishing activities. These costs are expected to be minor, but should increase as the size of the buffer zone[17] increases. One can conclude with some degree of certainty that the Net National Benefits associated with **Alternative 2** will be greater than that under the status quo (**Preferred Alternative 1**) if the created buffer zones allow aquaculture firms to operate more efficiently and are a reasonable size. Buffer zones that are too large or too small may result in a loss in Net National Benefits if the economic losses to other sections are more than benefits derived by the aquaculture firms. However, **Preferred Alternative 1** is likely to reduce user conflicts, especially with recreational and commercial fishermen, and therefore would provide the greatest net benefit to the social environment.

The establishment of buffer zones is primarily administrative and would therefore directly effect this environment. Selecting **Alternative 2** would require demarcation of the boundary area around all permitted aquaculture facilities and enforcement of this boundary area. The enforcement of these boundary areas would most likely have the greatest affect on the administrative environment, as at sea enforcement is difficult and expensive. The creation of a buffer zone would potentially allocate resources, particularly those of law enforcement, away from their primary focus, and could therefore, indirectly affect the administrative environment.

4.8 Action 8: Recordkeeping and Reporting

Alternative 1: No Action, the Regional Administrator has authority to specify recordkeeping and reporting requirements in an EFP (50 CFR 600.745).

Preferred Alternative 2: Establish the following reporting and recordkeeping requirements for aquaculture permits:

a) Provide NOAA Fisheries Service with copies of state, ACOE and EPA permits and monitoring reports.

b) Report all fish to be landed or harvested from the facility to NOAA Fisheries Service

c) Report all incidents of any disease or parasites impacting greater than 10 percent of the cultured organisms immediately after diagnosis to NOAA Fisheries Service. Information

17 One (potential) additional cost discussed in the literature reflects aggregation of fish around the structures. If aggregation is significant, catch per unit effort outside the buffer zone may decrease.

reported would include percent of cultured organisms infected, a plan of action for managing the disease outbreak with treatment, and consultations with marine fish disease specialists.

d) Notify NOAA Fisheries Service of any of the following events:
i. Major escapement and reasons for escapement. Major escapement is defined as cumulative escapement of 10 percent or more of stocked fish;
ii. entanglements or interactions with marine mammals, endangered species, and migratory birds.

e) Notify NOAA Fisheries Service of any changes in sources used for providing fingerlings

f) Keep copies of feed labels on file for three years from date of use.

g) Keep all harvest and sale records for three years. Sale records should include the names of companies and individuals to whom fish are sold.

h) Inform NOAA Fisheries Service when the type of aquaculture system used for culture is changed.

i) All new species to be cultured should be approved by NOAA Fisheries Service prior to introduction to the offshore growout facility.

j) Require a standardized annual report to address activities in these areas.

k) Any other appropriate recordkeeping and reporting requirements, as specified by the NOAA Fisheries Service Regional Administrator, necessary for issuance, review, and administration of an aquaculture permit.

Discussion and Rationale

Section 6.9 examines the effects of the various Action 8 alternatives relative to each other within the biological, physical, ecological, economic, social, and administrative environments. Recordkeeping and reporting requirements are meant to allow both aquaculture facilities and NOAA Fisheries Service to examine the operation and thereby the impacts to the physical, biological, and ecological environments. These reports will act as the check and balance system in the time periods between permit issuance and renewal. By requiring annual reports (at a minimum), managers can assess all aspects of a facility and its operation. These recordkeeping and reporting requirements are intended to mitigate impacts associated with marine aquaculture and alert managers to potential problems. If potential problems arise, these requirements will allow NOAA Fisheries Service to work with a facility to resolve potential problems and environmental impacts, or revoke the facilities permit if problems and impacts persist. Reporting the source of fingerlings, numbers of fish landed or harvested, and to whom fish are sold will help NOAA Fisheries to track mortality and yield of managed stocks (National Standard 1).

Similarly, requiring aquaculture operations to report entanglements will allow NOAA Fisheries Service to assess if aquaculture systems are minimizing bycatch of fishes, sea birds, marine mammals, and sea turtles to the extent practicable (National Standard 9).

These recordkeeping and reporting requirements are intended to ensure the operations of all offshore aquaculture facilities permitted in the Gulf of Mexico are consistent with the MSFCMA National Standards (Section 6.10) and do not compromise Council objectives for wild fisheries (see Section 3.0 for list of objectives). These reporting and recordkeeping requirements will assist the Council in promoting the development of a robust commercial aquaculture industry in the Gulf of Mexico, without threatening the long-term sustainability or viability of wild fisheries or their contributions to the local, regional, and national economies.

Summary Comparison of Physical, Biological, and Ecological Consequences

Some information contained in recordkeeping and reporting is designed to monitor the effects a facility has on the physical, biological, and ecological environment. By establishing reporting requirements, the impacts of an aquaculture facility on the physical, biological, and ecological environment can be examined. Where appropriate, additional conditions of an aquaculture's operation could be implemented to mitigate these impacts and therefore, reduce the effects on these environments.

Section 6.1 discusses the environmental impacts associated with marine aquaculture. As mentioned in the discussion for Action 1, environmental concerns are largely associated with: 1) Modification of wild stock genetic diversity; 2) transmission of infectious disease to wild stocks; 3) modification of benthic habitat from discharged effluents, such as solids, and dissolved nutrients; 4) escaped fish competing with wild fish; 5) entanglement of wildlife with aquaculture structures; and 6) use of prey species for feed. The effects of each of these are not repeated here, but are described in more detail in Section 6.1.

Alternative 1 would not specify recordkeeping and reporting requirements but may continue to allow the RA authority to specify EFP recordkeeping and reporting requirements if Action 1, Alternative 1 (Exempted Fishing Permit) is selected as the preferred alternative. Because Action 1, Alternative 2 (NOAA Fisheries Service permit to operate a facility) was selected by the Council as the preferred, only **Alternative 2** can be selected for Action 8. The greatest impacts to the biological and physical environments would have occurred if the Council did not select a preferred alternative for Action 8. By not selecting a preferred alternative, aquaculture operations would not have to meet recordkeeping and reporting requirements. There would be no checks and balances system to monitor environmental impacts. This could negatively affect the physical and biological environments by degrading habitat, spreading disease, and allowing fish escapement.

Instead, **Preferred Alternative 2** will require aquaculture facilities to meet multiple recordkeeping and reporting requirements. These requirements include various reporting requirements, such as notifying NOAA Fisheries Service of escapement, disease

outbreaks, and entanglements. These reporting requirements would also benefit enforcement, by providing them with information on when fish are harvested and landed and requiring facilities to maintain harvest and sale records. Facilities would be required to provide NOAA Fisheries Service with an annual report each year addressing all of the reporting requirements listed in **Alternatives 2(a-i)**. Overall, **Preferred Alternative 2** would provide NOAA Fisheries Service with sufficient information to monitor and assess the impacts of an aquaculture facility when determining compliance with permit conditions. **Preferred Alternative 2** would help mitigate any environmental impacts by alerting NOAA Fisheries Service to potential problems that can then be resolved.

Under either alternative, aquaculture operations would still have to abide by any permit conditions specified by other federal agencies (e.g., EPA NPDES permit, etc.)

Summary Comparison of Socioeconomic and Administrative Consequences

Recordkeeping and reporting requirements are being considered to enable NOAA Fisheries Service to monitor the activities and impacts of the offshore aquaculture industry. Adding recordkeeping and reporting requirements increases costs for the industry and the agency collecting the data, but the benefits of collecting that information are assumed to outweigh those costs. The actual costs will likely vary by business. The costs businesses will incur are not expected to be overly burdensome.

The National Aquaculture Act of 1980, as amended, directs the Secretary of Commerce to collect and analyze scientific, technical, legal, and economic information relating to aquaculture, including acreages, water use, production, marketing, culture techniques, and other relevant matters. Guidance from the National Aquaculture Act indicates that relevant physical, biological, and economic information should be collected from aquaculture facilities. The types of information described in that Act are similar to the information requested under **Preferred Alternative 2**.

Proprietary information submitted to the Secretary is considered confidential and may only be disclosed if required under court order. The Secretary may release or make public any information in any aggregate or summary form that does not directly or indirectly disclose the identity, business transactions, or trade secrets of any person who submits the required information under the status quo or **Preferred Alternative 2**.

Costs incurred by Federal agencies and the industry as a result of selecting the status quo are expected to be similar to those required under an EFP. The costs incurred by firms that have submitted EFPs for aquaculture in the past are not available. The costs for NOAA Fisheries Service to review the documents would depend on the reports submitted. Applications that are incomplete or do not meet the EFP guidelines could be quickly rejected. Applications requiring more thorough review would take more time and be more expensive.

The costs to submit the EFP were likely a small part of the overall cost a business would have incurred to develop their business plan, meet all the regulatory requirements, and start production. Based on information provide by Posadas (2003), $30,000 represents

one percent of the first year production costs of his hypothetical firm. So, it is unlikely that permit applications and recordkeeping and recording requirements will constitute a substantial portion of the initial budget.

Producer surplus will decline as additional costs are imposed on firms. The reduction in producer surplus is assumed to be an acceptable tradeoff for obtaining information that would allow NOAA Fisheries Service to better manage public resources. Consumer surplus cannot be estimated because information is not available on production of seafood from the firms that may apply for permits and the value U.S. consumers would assign to that product. However, it is assumed that consumer surplus will increase if the supply of quality fish on the market increases.

Preferred Alternatives 2(f) and **2(g)** require the firm to retain information on the feed that was used by the firm and the harvest and sales records of the firm. The conditions under which NOAA Fisheries Service or NOAA GC could access those records are not defined in this action, but it is assumed that if NOAA Fisheries Service had cause to review those records they would be available. As discussed in Section 6.1.3.1, the composition and integrity of feed can negatively affect organic loading (Rapp 2006). Maintaining feed labels would potentially allow NOAA Fisheries Service to assess whether feed composition is a cause of negative environmental effects, such as increased organic loading. The cost of maintaining the feed labels would include the labor cost associated with collecting and filing the labels and the cost of file cabinets or other devices used to store the labels for the required three years. Retaining copies of sales receipts is considered a reasonable practice for most businesses. Similar information would likely be required for tax and other purposes, so implementing the requirement should not create additional costs.

Preferred Alternative 2(a) requires the firm to supply copies of permits and monitoring reports that are generated for other agencies. The cost of submitting those reports would be the cost of obtaining a copy of the original report (or making copies) and the labor costs associated with obtaining the reports and mailing them to the agency. **Preferred Alternative 2(b)** would require the firm to submit a report for all fish harvested or landed from their facility. The information would likely be submitted on a form (paper or electronic) that would be generated by NOAA Fisheries Service that is similar to commercial trip tickets. The cost of submitting this information would be similar to that incurred by commercial harvesters or processors when they submit trip ticket or logbook reports. The frequency of the submissions would depend on the number of times a firm harvests their stock, since it is assumed a report must be submitted every time fish are harvested. The number of reports annually would vary by business. The remainder of the options would trigger the submission of information to NOAA Fisheries Service under specified conditions and a report would need to be submitted every time the condition is met.

Preferred Alternatives 2(c) and **2(d)** would mandate that the permit holders provide NOAA Fisheries Service with information when a disease outbreak, escapement, or entanglement occurs. The cost of submitting the report is not expected to be time

consuming or costly, but the information being made available to NOAA Fisheries Service could be important for fisheries management.

Alternatives 2(e), **2(h)**, and **2(i)** would require the aquaculture firm to report information that updates the permit application(s). Minor changes could simply amend the current permit, while major changes could trigger the submission of a new permit application.

Alternative 2(j) would require the firm to submit an annual standardized report that would be developed by NOAA Fisheries Service to summarize the information requested in **Alternatives 2(a)-2(i)**. The information requested would be an annual report on the activities of the firm that were already required. The additional report will require time to complete, but since NOAA Fisheries Service will develop the required questions and provide them on standardized form the firm should be able to collect and organize the required data throughout the year. The time requirements should be no greater than the 1-hour required to submit an EFP.

NOAA Fisheries Service will also incur costs developing the data collection instruments, collecting the data, and storing the data. The form should be relatively easy to develop given the types of information being requested. The time required to store the data depends on how NOAA Fisheries Service will use the information. If the data are stored in an electronic format, NOAA Fisheries Service could produce summarized data on the activities of the industry. Those reports could be made available to the general public in an aggregate non-confidential format to provide information on how well the industry is performing in terms of production and environmental impacts.

No special skills would be needed to provide these reports. The information contained in the reports would require the firm to summarize findings from marine fish disease specialists they hire to maintain the health of their stocks. Those expenses would accrue as part of the normal health maintenance program employed by the firm. The ability to use a computer would be required to submit electronic reports. Hard-copy reports would not require any special skills.

Record keeping and reporting is an administrative function and would directly affect this environment. The administrative environment of both the aquaculture facility in maintaining and submitting these records, as well as the administrative environment of NOAA Fisheries Service, in the review process would be burdened by the requirement to maintain records.

5.0 Affected Environment

Both the physical environment and biological environment for Gulf fisheries are described in detail in the EIS for the Generic Essential Fish Habitat Amendment, which is incorporated here by reference (GMFMC 2004). Summaries of that information are presented in the following subsections.

5.1 Physical Environment

The Gulf of Mexico is bounded by Cuba, Mexico, and the U.S., and has a surface area of 1.51 million km^2 (Wiseman and Sturges 1999). It is a semi-enclosed, oceanic basin connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel. Conditions in the Gulf of Mexico are primarily affected by the Loop Current, the discharge of freshwater into the Northern Gulf, and a semipermanent, anticyclonic gyre in the western Gulf.

5.1.1 Geological Features

The Gulf of Mexico can be divided into two major sediment provinces (Fig. 5.1.1-1). East of DeSoto Canyon and southward along the west Florida coast, sediments are primarily carbonates. Coarse surface deposits include quartz sand, carbonate sand, and mixtures of the two. To the west of DeSoto Canyon, sediments are terrigenous. Coarse sediments make up the very shallow nearshore bottoms from the Texas/Mexican border to off central Louisiana from the shore to the central third of the shelf. Beyond depths of 80 m, fine sediments are also strongly represented. Fine sediments are limited to the northern shelf under the influence of the Mississippi and Atchafalaya Rivers.

The west Florida shelf provides a large area of hardbottom habitat. It is comprised of low relief hardbottoms that are relict reefs or erosional structures. Some high relief can be found along the shelf edge in waters 130 to 300 m deep. Hardbottom provides extensive areas where reef biota such as corals can become established. These hardbottom have become important reef fish fishing areas and some areas, such as the Tortugas North and South closed areas, the Florida Middle Ground habitat area of particular concern (HAPC), the Steamboat Lumps closed area, and the Madison and Swanson closed area limit fishing activities within their boundaries.

Off the Alabama/Mississippi shelf and shelf break, irregular-shaped aggregates of calcareous organic forms called pinnacles are found. These pinnacles average about 9 m in height and are found in waters about 80 to 130 m deep. In addition to the pinnacles, low-relief hardbottom areas can be found in waters less than 40 m adjacent to Florida and Alabama.

While the Louisiana/Texas shelf is dominated by muddy or sandy terrigenous sediments, banks and reefs do occur on the shelf. Rezak et al. (1985) grouped banks into the mid-shelf banks, (defined as those that rise from depths of 80 m of less and have a relief of 4 to 50 m) that are made of relatively bare, bedded Tertiary limestones, sandstones, claystones, and siltstones, and relict reefs (defined as those that rise from water depths of 14 to 40 m and have a relief of 1 to 22 m) that are relict carbonate shelf. The Flower Garden Banks National Marine Sanctuary is located about 150 km directly south of the Texas/Louisiana border. This coral reef is perched atop two salt domes rising above the sea floor and ranges from 15 to 40 m deep.

5.1.2 Oceanographic Features

Most of the oceanic water entering the Gulf flows through the Yucatan Channel, a narrow (160 km wide) and deep (1,650-1,900 m) channel. Water leaves the Gulf through the Straits of Florida, which is about as wide as the Yucatan Channel, but not nearly as deep (about 800 m). This pattern of water movement produces the most pronounced circulation feature in the Gulf of Mexico basin, known as the Loop Current with its associated meanders and intrusions. After passing through the Straits of Florida, the Loop Current, also known as the Florida Current at this stage, merges with the Antilles Current to form the Gulf Stream.

Runoff from precipitation on almost two-thirds of the land area of the U.S. eventually drains into the Gulf of Mexico via the Mississippi River. The combined discharge of the Mississippi and Atchafalaya Rivers alone accounts for more than half the freshwater flow into the Gulf and is a major influence on salinity levels in coastal waters on the Louisiana/Texas continental shelf. The annual freshwater discharge of the Mississippi/Atchafalaya River system represents approximately 10 percent of the water volume of the entire Louisiana/Texas shelf to a depth of 90 m. The Loop Current and Mississippi/Atchafalaya River system, as well as the semi permanent, anticyclonic gyre in the western Gulf, significantly affect oceanographic conditions throughout the Gulf.

5.1.2.1 Temperature

The physical characteristics of the Gulf of Mexico have been extensively mapped. Darnell et al. (1983) mapped physical parameters for the northwestern Gulf of Mexico (the Rio Grande River to the Mississippi River). Bottom temperature was mapped for the coldest and warmest months (January and August). During January, the shallowest waters of the central shelf ranged between 12° C and 14° C. The temperature increased with depth, with a broad band of warmer water, between 17° C and 19° C, across the middle to deeper shelf However, on the outer shelf off central Louisiana and south Texas, temperatures dropped below 17° C, presumably due to the intrusion of cold deeper waters in both areas.

During August, the shallowest waters of the central shelf reached 29° C, and bottom water temperatures decreased almost regularly with depth, attaining lows of around 17° C to 18° C toward the outer shelf. Thus, bottom temperatures showed a seasonal range of 15° C or more. On the outer shelf the seasonal range was only 2° C or less.

Darnell and Kleypas (1987) mapped the eastern Gulf of Mexico (Mississippi River to the Florida Keys), following the same protocol as Darnell et al. (1983) in gathering bottom temperature data during January and August. During the months of January, the coldest shelf water (14° C) appeared just off the Mississippi barrier islands. Water colder than 16° C occupied the nearshore shelf out to the 25-m isobath from the Chandeleur Islands to Cape San Blas, Florida, and below that point it extended to the 20-m isobath to northern Tampa Bay. West of DeSoto Canyon all bottom shelf waters were below 18° C. However, east of DeSoto Canyon, all outer shelf waters exceeded 18°C, and the 18°C and

20° C isotherms passed diagonally shoreward across the isobaths so that all shelf waters from just above Charlotte Harbor to the Florida Keys were 18° C or above. The maximum January temperature (22° C) was encountered near the southern tip of the Florida shelf at a depth of 60 to 70 m.

During August, the temperature of the nearshore bottom water ranged from 26° C near Panama City, Florida, to 30° C around Cedar Keys, Florida. Throughout the eastern Gulf shelf; bottom water temperatures decreased with depth. Near the Mississippi River Delta the outer shelf water was 22° C, but temperatures down to 16° C were observed along both the eastern and western rims of DeSoto Canyon and at several localized areas along the outer shelf of Florida. For most of the shelf of the Florida peninsula, bottom isotherms paralleled the isobaths.

Seasonal comparisons reveal that nearshore waters for the entire eastern Gulf shelf were 10° C to 15° C warmer in the summer than in the winter. Near the Mississippi River Delta, the bottom waters of the outer shelf were only about 5° C warmer in the summer than during the winter. However around the rim of DeSoto Canyon and along the shelf of Florida, summer temperatures ranged 1° C to 4° C colder in the summer than in the winter. This summer temperature depression is due to the intrusion of colder slope water onto the outer shelf during the summer months.

Figures 5.1.2.1-1 and 5.1.2.1-2 show sea surface temperature (SST) derived using the National Oceanographic Data Center and the University of Miami's Rosenstiel School of Marine and Atmospheric Sciences' Advanced Very High Resolution Radiometer Version 5.0 Pathfinder SST data from 1985-2001. Figure 5.1.2.1-1 depicts the monthly SST average for February, the coldest month, while Figure 5.1.2.1-2 depicts the monthly SST average for August, the warmest month. During February, average surface temperatures ranged from 15° C in the northern Gulf to 26° C between the Yucatan Peninsula and Cuba. During August, surface temperature for most of the Gulf of Mexico averaged either 29° C or 30° C. See Figure 5.1.2.1-1. Sea Surface Temperatures for February. See Figure 5.1.2.1-2. Sea surface temperatures for August.

5.1.2.2 Salinity

Surface salinities in the Gulf of Mexico vary seasonally. During months of low freshwater input, surface salinities near the coastline range between 29 and 32 ppt (MMS 1997). High freshwater input conditions during the spring and summer months result in strong horizontal salinity gradients with salinities less than 20 ppt on the inner shelf in the northern Gulf of Mexico. The waters in the open Gulf are characterized by salinities between 36.0 and 36.5 ppt (MMS 1997).

5.1.2.3 Hypoxia

Hypoxic waters occur when dissolved oxygen levels drop below 2 mg/L. In the northern Gulf of Mexico, a major and annually consistent area of hypoxia may occur from late February through early October extending from near the mouth of the Mississippi River

to near the mouth of the Sabine Rive nearly continuously from mid-May through mid-September. The hypoxic area is most widespread, persistent, and severe in June, July, and August (Rabalais et al. 1999). Hypoxic waters in this zone can include 50 to 80 percent of the lower water column between 5 and 30 m water depth, and can extend as far as 130 km offshore to depths of 60 m (Rabalais and Turner 2001). Between 1985 and 1992, hypoxia generally formed two areas west of the Mississippi and Atchafalaya River deltas, with the total area averaging 8,000 to 9,000 km^2. After the Mississippi River flooded in 1993, the size of the hypoxic zone doubled in area forming a single continuous zone across the Louisiana continental shelf (Rabalais et al. 2002). In 2002, the hypoxic zone covered approximately 22,000 km^2 of the Louisiana-Texas shelf. Other smaller hypoxic zones may form in Gulf of Mexico bays and offshore waters periodically, but less regularly than in the Louisiana offshore area.

5.1.2.4 Turbidity

Riverine inputs, wind, and currents are the primary agents that cause turbidity in Gulf waters. Turbidity levels in the western and northern Gulf are higher than the eastern Gulf because of more sources of freshwater input. Surface turbidity is limited to areas of riverine inputs with the Mississippi and Atchafalaya Rivers the primary inputs for the Gulf. During the low water periods, the amount of sediment in suspension averages 0.260 g/L. The amount of sediment increases to 0.640 g/L during high water (flood) periods. These turbid waters are delivered to offshore locations by tidal currents and winds.

Another type of turbidity that is found near the bottom is called the nepheloid layer. This is a body of moving, suspended sediment that is formed when the turbulence of bottom waters is high enough to offset the settling (gravity driven) of the sedimentary particles. Along the south Texas continental shelf, Shideler (1981) found that the nepheloid layer thickened offshore to a maximum of 35 m near the shelf break and that the concentration of suspended sediment in the nepheloid layer decreased from a maximum nearshore to a minimum at the shelf break.

Rezak et al. (1985) studied the nepheloid layer on the Louisiana/Texas shelf from 1979 to 1982. Inshore of the 10-m isobath the water was turbid from top to bottom. Offshore of the 10-m isobath, the top 2 to 3 m of water are turbid with a layer of clear water between the bottom nepheloid layer and the top layer of turbid water. The nepheloid layer at the base of the water column up to 50 km offshore was heavily laden with suspended sediment. The nepheloid layer extends across the shelf in a well mixed bottom layer 10 to 15 m thick, and spills over onto the continental slope. At the shelf break, the nepheloid layer wells up to more than 25 m in thickness. Rezak et al. (1985) concluded that the sediment in the nepheloid layer is kept in suspension over much of the inner shelf by swift currents.

5.1.3 Areas for Aquaculture

5.1.3.1 Areas where aquaculture may be currently prohibited

See Figure 5.1.3.1-1 Prohibited Aquaculture Areas East
See Figure 5.1.3.1-2 Prohibited Aquaculture Areas West

5.1.3.1.1 Marine reserves

Madison/Swanson and Steamboat Lumps Marine Reserves – These areas are no-take marine reserves sited on gag spawning aggregation areas where all fishing, except for surface trolling during May through October, is prohibited (219 square nautical miles). The Madison/Swanson site was also identified as a Habitat Area of Particular Concern (HAPC) by the Council.

Tortugas North and South Ecological Reserves – These areas are no-take marine reserves cooperatively implemented by the state of Florida, National Ocean Service (NOS), the Council, and the National Park Service (185 square nautical miles). These areas prohibit fishing for any species and bottom anchoring by fishing vessels.

5.1.3.1.2 Areas used by the Coast Guard

Current regulations prohibit siting of aquaculture facilities in areas managed for public use by the U.S. Coast Guard. These areas include lightering areas (where oil is offloaded from vessels), anchorages, outer continental shelf safety zones, deepwater port safety zones (for the Louisiana Offshore Oil Port and the Gulf Gateway Port), and shipping fairways.

5.1.3.1.3 Areas prohibited by the Mineral Management Service

The Energy Policy Act of 2005 gave the Secretary of the Interior authority to issue a lease, easement, or right-of-way on the Outer Continental Shelf for activities that use oil and gas facilities for other (non-energy related) authorized marine-related purposes, such as aquaculture. The MMS published a final Programmatic Environmental Impact Statement in November 2007 which assesses the impacts of allowing the use of energy facilities for non-energy related purposes. The MMS is expected to make a final decision on this action in December 2007, with additional regulations to follow.

5.1.3.1.4 Areas activity prohibited by the U.S. Army Corps of Engineers

ACOE regulations prohibit aquaculture activities from occurring in disposal areas and their vicinity, navigation channels, borrow sites, and federal mitigation areas.

5.1.3.2 Other environmentally sensitive areas

See Figure 5.1.3.2-1 Areas of Concern East
See Figure 5.1.3.2-2 Areas of Concern West

5.1.3.2.1 HAPCs

The Council has established a number of HAPCs. The regulations in these areas vary and may, in some cases, allow aquaculture to occur (Generic EFH Amendment 3 or 50 CFR 622.34).

Individual reef areas and bank HAPCs of the northwestern GOM include: East and West Flower Garden Banks, Stetson Bank, Sonnier Bank, MacNeil Bank, 29 Fathom, Rankin Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Rezak Sidner Bank, Alderice Bank, and Jakkula Bank. Bottom anchoring by fishing vessels and the use of trawling gear, bottom longlines, buoy gear, dredge gear, and all traps/pots on coral reefs are prohibited in the East and West Flower Garden Banks, McGrail Bank, and Stetson Bank (263.2 square nautical miles).

Florida Middle Grounds HAPC – Pristine soft coral (348 square nautical miles). All gear interfacing with the bottom is prohibited.

Pulley Ridge HAPC – A portion of the HAPC (110 square nautical miles) where deepwater hermatypic coral reefs are found is closed to anchoring of fishing vessels and the use of trawling gear, bottom longlines, buoy gear, dredge gear, and all traps/pots (2,300 square nautical miles).

5.1.3.2.2 Hypoxic zones

As discussed in Section 5.1.2.3, hypoxia can extend over vast areas of the Louisiana and upper Texas continental shelf. In order to avoid impacts to aquaculture organisms from low dissolved oxygen levels and having waste matter from aquaculture operations contributing to the hypoxic zone, areas that experience frequent hypoxia should be avoided.

5.1.3.2.3 Areas where harmful algal blooms frequently occur

Harmful algal blooms or red tide are common on the west Florida continental shelf. In order to avoid potential losses of all organisms due to harmful algal blooms, companies and regulators should investigate the history of occurrence of harmful algal blooms for any location they are considering.

5.1.3.2.4 Ecological areas of concern

Currently unprotected hardbottom areas exist that should be avoided when siting aquaculture facilities. For example, the Pinnacles area located on the Mississippi and Alabama continental shelf consists of a 1.6 km wide band of shelf-edge features in water depths ranging from 68 to 101 m. These pinnacles have vertical relief of about 9 m with some exceeding 15 m (Continental Shelf Associates, Inc. and Texas A&M University 2001).

Seagrasses are very sensitive to anthropogenic disturbances and have a very low recovery capacity. Effluents from aquaculture operations might also have a negative effect on seagrass. Fish farming releases high organic and nutrient loading into the surroundings (Beveridge 2004). Organic matter may accumulate in the sediment under and nearby cages, degrading the benthic macrophyte communities, especially seagrass (Perez et al. 2005). Therefore, aquaculture facilities should avoid seagrass areas.

5.1.3.2.5 Sites designated as "No Activity Zones" by the Mineral Management Service

Several shelf edge, midshelf, and low relief banks with coral reef community organisms exist off of Louisiana and Texas. These banks are protected from potential oil and gas development impacts by the Minerals Management Service through a Topographic Features Stipulation (MMS 2002), which establishes a "No Activity Zone" at each bank that prohibits any structure, drilling rig, pipeline, or anchoring within the zone. The Council may consider following the MMS' lead and prohibiting aquaculture in these areas because they have been found to be ecologically important. Extensive hardbottom areas exist on the west Florida shelf, and these areas should also be avoided, to the extent practicable.

5.1.3.3 Other special management areas

See Figure 5.1.3.3-1 Artificial Reefs East
See Figure 5.1.3.3-1 Artificial Reefs West

5.1.3.3.1 Traditionally highly fished areas

One of the many uses of the Gulf of Mexico is commercial and recreational fishing. Since aquaculture facilities will have some type of physical footprint, facilities should avoid user conflict as much as possible. One way to reduce user conflict with the fishing industries is, to the extent practicable, site aquaculture facilities outside of traditional highly fished areas. Aquaculture facilities should not be sited around artificial reefs, in artificial reef zones, or in highly trawled or fished areas. Siting criteria specified for Action 6, Preferred Alternative 4, includes NOAA Fisheries Service consideration of traditional fishing areas when siting an offshore aquaculture facility.

5.1.3.3.2 Alabama Special Management Zone (SMZ)

In the Alabama SMZ, fishing by a vessel operating as a charter vessel or headboat, a vessel that does not have a commercial permit for Gulf reef fish, or a vessel with such a permit fishing for Gulf reef fish, is limited to hook-and-line gear with no more than 3 hooks. Nonconforming gear is restricted to bag limits, or for reef fish without a bag limit, to 5 percent by weight of all fish aboard.

5.1.3.3.3 Areas of current or future oil and gas activities, dredge disposal, and military warning areas.

Approximately 4,000 oil and gas platforms exist in the Gulf of Mexico. Thousands of miles of oil and gas pipeline are buried throughout the Gulf of Mexico. When determining a site location, aquaculture companies and regulators should consider current and future oil and gas activities. Several interim and final unconfined dredge material disposal areas exist offshore of the major shipping channels throughout the Gulf of Mexico. Aquaculture companies and regulators should be aware of the potential problems unconfined dredge material disposal could have on facility operations. Aquaculture companies and regulators should also be aware that boat operations and aircraft use could be affected if facilities are sited in military warning areas.

5.1.3.3.4 Ordnance zones

The U.S. Air Force has released an indeterminable amount of unexploded ordnance in some areas of the Gulf of Mexico. The exact location of the unexploded ordnance is unknown, and drilling or other activities may be potentially hazardous in these areas. Zones where this ordnance may occur have been defined.

5.1.4 Possible environmental guidelines for siting of aquaculture facilities

Site selection is a key factor in any aquaculture project, affecting both the economic viability and the sustainability of the project. While correct siting is important for economic reasons, it is also important for environmental reasons. Culture of any species must be established in geographical regions having adequate water quality and exchange. Offshore aquaculture cages should be located in areas with a suitable surrounding environment. Variables to consider in site selection include water depth, water quality, currents, and sediment type (Buitrago et al. 2005; Hunter et al. 2006; Kapetsky and Aguilar-Manjarrez 2007; Levings et al. 1995; Perez et al. 2005; Ross et al. 1993).

5.1.4.1 Water Depth

Water depth requires detailed consideration for cage suitability as it has an influence on net size, anchoring system, and anchoring method. Cages may be damaged in shallow water, whereas anchoring systems needed for deeper waters may become limiting, giving a greater risk of losing stock. Cages should be located at sites where the water depth is sufficient to maximize water exchange and to keep cage bottoms well clear of bottom substrates. Conversely, costs and problems associated with cage anchoring increase with depth.

In order to avoid waste accumulation and cage damage during storms, water depths for cage aquaculture should be limited to areas where water depths are greater than one and one half times the cage height (Ross et al. 1993). Therefore, if a cage was 20 m in depth,

it would require at least 30 m of water. Kapetsky and Aguilar-Manjarrez (2007) reviewed depth thresholds for cages based on a review of current experimental and commercial installations in the United States. They also examined specifications given by cage manufacturers worldwide. The minimum site depth found was 25 m. Kapetsky and Aguilar-Manjarrez (2007) recommended a minimum depth of 25 m in order to avoid waste accumulation under cages. They established 100 m as the maximum depth for anchored cages since inspection of mooring and anchoring systems in depths greater than 100 m would be difficult.

5.1.4.2 Water Quality

Water quality considerations include temperature, dissolved oxygen, and salinity. As detailed in Section 5.1.2.1, temperature can vary widely between seasons and locations in the Gulf of Mexico. Water temperature is the environmental parameter which has the most effect on fish (Lawson 1995). Temperatures on either side of the optimum can induce stress in the animal, affecting feeding, growth, reproduction, and disease inhibition. Facilities should be sited so that cultured species are within their optimum temperature range. Low dissolved oxygen can have a variety of physiological effects on cultured organisms, impacting growth and mortality. For most areas of the Gulf of Mexico, below optimum dissolved oxygen levels are not a problem. Off the coast of Louisiana, hypoxia can affect thousands of square kilometers each summer. While primarily affecting bottom waters between 5 and 30 m off Louisiana, hypoxia can affect 50 to 80 percent of the water column, occur in water depths out to 60 m, and extend onto the upper Texas shelf (Rabalais and Turner 2001). Salinity also varies widely seasonally and across the Gulf of Mexico.

5.1.4.3 Current speed

The Loop Current enters the Gulf of Mexico through the Yucatan Channel, turns clockwise and exits through the Straits of Florida. The speed of the Loop Current may exceed 2 m/sec. The intrusion of the Loop Current into the Gulf of Mexico varies. As the current travels farther north, it tends to shed eddies as large as 400 km or more in diameter that slowly move westward at speeds of approximately 5 cm/sec (Wiseman and Sturges 1999). These eddies carry massive amounts of heat, salt, and water into the western Gulf. Currents over the inner continental shelf in the Gulf of Mexico are strongly wind driven out to depths of approximately 50 to 60 m (Wiseman and Sturges 1999). Current speeds over the inner shelf therefore vary.

Water currents are very important for cage site selection because they are integral to the water exchange rate and help in avoiding waste accumulation underneath cages. Bottom currents should be above 5 cm/s (Ross et al. 1993, Hambrey and James 2005), but water exchange and waste accumulation are a factor of depth and current speed. The recommendation of 5 cm/s was based upon having more than the one and one half times the cage height underneath the cages. As the depth decreases towards the minimum of one and one half times the cage height, currents will need to be faster to avoid waste accumulation. While current offshore cage designs can handle sustained currents of over

100 cm/s, currents faster than this can adversely affect organisms, contribute towards food losses, and make maintaining the cages difficult. Excessive currents can also resuspend wastes underneath cages. Therefore, areas with sustained currents over 100 cm/s should be avoided.

5.1.4.4 Sediment type

In the eastern Gulf of Mexico, sediments are primarily coarse carbonates. To the west of DeSoto Canyon, sediments are terrigenous with a mixture of coarse and fine sediments. Sediment type can potentially affect the type of anchors or moorings used for cages and can also affect the rate of processing of organic waste from the cages. See Figure 5.1.1-1 Sediment Type

5.2 Biological Environment

5.2.1 Life History and Biology

The biological environment of the Gulf of Mexico, including the species addressed in this DSEIS, is described in detail in the final EIS for the Generic Essential Fish Habitat amendment and is incorporated here by reference (GMFMC 2004).

5.2.2 Gulf of Mexico Species Suitable for Aquaculture

Most reef fish and coastal migratory pelagic species could be raised in aquaculture systems, but likely only those commanding the highest value or with the highest growth rates will be raised. Cobia are now being successfully raised in net pens off Puerto Rico. Additionally, over the last eight years NOAA has funded numerous research studies pertaining to cobia, mutton snapper, and greater amberjack. Hatchery technology, breeding programs, and larval rearing techniques for cobia and mutton snapper have been successfully developed. The Gulf of Mexico Marine Stock Enhancement Program (GMMSEP) has also conducted research for administering live food to larval red snapper. Red snapper were successfully spawned naturally in captivity and release experiments were conducted to evaluate the post-release survival of red snapper. Research and development activities are also underway in Puerto Rico to refine culture technology for spiny lobster. Lastly, several states currently operate red drum aquaculture programs in the Gulf of Mexico, making this species a viable option for use in offshore aquaculture.

5.2.3 Status of Stocks

5.2.3.1 Council Managed Species

The National Ocean Service (NOS) of NOAA collaborated with NOAA Fisheries Service and the Council to develop distributions of reef fish (and other species) in the Gulf (SEA 1998). NOS obtained fishery-independent data sets for the Gulf, including SEAMAP, and state trawl surveys. Data from the Estuarine Living Marine Resources (ELMR) Program contain information on the relative abundance of specific species (highly

abundant, abundant, common, rare, not found, and no data) for a series of estuaries, by five life stages (adult, spawning, egg, larvae, and juvenile) and month for five seasonal salinity zones (0-0.5, 0.5-5, 5-15, 15-25, and >25). NOS staff analyzed the data to determine relative abundance of the mapped species by estuary, salinity zone, and month. For some species not in the ELMR database, distribution was classified as only observed or not observed for adult, juvenile, and spawning stages.

In general, reef fish are widely distributed in the Gulf, occupying both pelagic and benthic habitats during their life cycle. Habitat types and life history stages are summarized in Table 5.2.3.1-1 and can be found in more detail in GMFMC (2004). In general, both eggs and larval stages are planktonic. Larvae feed on zooplankton and phytoplankton. Exceptions to these generalizations include the gray triggerfish that lay their eggs in depressions in the sandy bottom, and gray snapper whose larvae are found around submerged aquatic vegetation (SAV). Juvenile and adult reef fish are typically demersal, and are usually associated with bottom topographies on the continental shelf (<100 m) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. Juvenile red snapper are common on mud bottoms in the northern Gulf, particularly off Texas through Alabama. Also, some juvenile snappers (e.g. mutton, gray, red, dog, lane, and yellowtail snappers) and groupers (e.g. goliath grouper, red, gag, and yellowfin groupers) have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC 1981). More detail on hard bottom substrate and coral can be found in the FMP for Corals and Coral Reefs (GMFMC and SAFMC 1982).

Table 5.2.3.1-1. Summary of habitat utilization by life history stage for most species in the Reef Fish FMP. This table is adapted from Table 3.2.7 in the final draft of the EIS from the Council's EFH generic amendment (GMFMC 2004a).

Common name	Eggs	Larvae	Post-larvae	Early Juveniles	Late juveniles	Adults	Spawning adults
Red snapper	Pelagic	Pelagic		Hard bottoms, Sand/ shell bottoms, Soft bottoms	Hard bottoms, Sand/ shell bottoms, Soft bottoms	Hard bottoms, Reefs	Sand/ shell bottoms
Queen snapper	Pelagic	Pelagic				Hard bottoms	
Mutton snapper	Reefs	Reefs	Reefs	Mangroves, Reefs, SAV, Emergent marshes	Mangroves, Reefs, SAV, Emergent marshes	Reefs, SAV	Shoals/ Banks, Shelf edge/slope
Schoolmaster	Pelagic	Pelagic		Mangroves, SAV	Hard bottoms, Mangroves, Reefs, SAV, Emergent marshes	Hard bottoms, Reefs, SAV	Reefs

Common name	Eggs	Larvae	Post-larvae	Early Juveniles	Late juveniles	Adults	Spawning adults
Blackfin snapper	Pelagic			Hard bottoms	Hard bottoms	Hard bottoms, Shelf edge/slope	Hard bottoms, Shelf edge/slope
Cubera snapper	Pelagic			Mangroves, Emergent marshes, SAV	Mangroves, Emergent marshes, SAV	Mangroves, Reefs	Reefs
Gray (mangrove) snapper	Pelagic, Reefs	Pelagic, Reefs	SAV	Mangroves, Emergent marshes, Seagrasses	Mangroves, Emergent marshes, SAV	Emergent marshes, Hard bottoms, Reefs, Sand/ shell bottoms, Soft bottoms	
Dog snapper	Pelagic	Pelagic		SAV	Mangroves, SAV	Reefs, SAV	Reefs
Mahogany snapper	Pelagic	Pelagic		Reefs, Sand/ shell bottoms	Reefs, Sand/ shell bottoms	Hard bottoms, Reefs, Sand/ shell bottoms, SAV	
Lane snapper	Pelagic		Reefs, SAV	Mangroves, Reefs, Sand/ shell bottoms, SAV, Soft bottoms	Mangroves, Reefs, Sand/ shell bottoms, SAV, Soft bottoms	Reefs, Sand/ shell bottoms, Shoals/ Banks	Shelf edge/slope
Silk snapper						Shelf edge	
Yellowtail snapper	Pelagic			Mangroves, SAV, Soft bottoms	Reefs	Hard bottoms, Reefs, Shoals/ Banks	
Wenchman	Pelagic	Pelagic				Hard bottoms, Shelf edge/slope	Shelf edge/slope
Vermilion snapper	Pelagic			Hard bottoms, Reefs	Hard bottoms, Reefs	Hard bottoms, Reefs	
Gray triggerfish	Reefs	Drift algae	Drift algae	Drift algae, Mangroves	Drift algae, Mangroves, Reefs	Reefs, Sand/ shell bottoms	Reefs, Sand/ shell bottoms
Greater amberjack	Pelagic	Pelagic	Pelagic	Drift algae	Drift algae	Pelagic, Reefs	Pelagic
Lesser amberjack				Drift algae	Drift algae	Hard bottoms	Hard bottoms
Almaco jack	Pelagic			Drift algae	Drift algae	Pelagic	Pelagic
Banded rudderfish		Pelagic		Drift algae	Drift algae	Pelagic	Pelagic
Hogfish				SAV	SAV	Hard bottoms, Reefs	Reefs

Common name	Eggs	Larvae	Post-larvae	Early Juveniles	Late juveniles	Adults	Spawning adults
Blueline tilefish	Pelagic	Pelagic				Hard bottoms, Sand/ shell bottoms, Shelf edge/slope, Soft bottoms	
Tilefish	Pelagic, Shelf edge/ slope	Pelagic		Hard bottoms, Shelf edge/slope, Soft bottoms	Hard bottoms, Shelf edge/slope, Soft bottoms	Hard bottoms, Shelf edge/slope, Soft bottoms	
Dwarf sand perch					Hard bottoms	Hard bottoms, Soft bottoms	
Sand perch						Reefs, SAV, Shoals/ Banks, Soft bottoms	
Rock hind	Pelagic	Pelagic				Hard bottoms, Reefs	Hard bottoms, Reefs
Speckled hind	Pelagic	Pelagic				Hard bottoms, Reefs	Shelf edge/slope
Yellowedge grouper	Pelagic	Pelagic			Hard bottoms	Hard bottoms	
Red hind	Pelagic	Pelagic		Reefs	Reefs	Hard bottoms, Reefs, Sand/ shell bottoms	Hard bottoms
Goliath grouper	Pelagic	Pelagic	Man-groves	Mangroves, Reefs, SAV	Hard bottoms, Mangroves, Reefs, SAV	Hard bottoms, Shoals/ Banks, Reefs	Reefs, Hard bottoms
Red grouper	Pelagic	Pelagic		Hard bottoms, Reefs, SAV	Hard bottoms, Reefs	Hard bottoms, Reefs	
Misty grouper	Pelagic	Pelagic				Hard bottoms, Shelf edge/slope	Hard bottoms
Warsaw grouper	Pelagic	Pelagic			Reefs	Hard bottoms, Shelf edge/slope	
Snowy grouper	Pelagic	Pelagic		Reefs	Reefs	Hard bottoms, Reefs, Shelf edge/slope	
Nassau grouper		Pelagic		Reefs, SAV		Hard bottoms, Reefs, Sand/ shell bottoms	Hard bottoms, Reefs, Sand/ shell bottoms
Black grouper	Pelagic	Pelagic		SAV	Hard bottoms, Reefs	Hard bottoms, Mangroves, Reefs	
Yellowmouth grouper	Pelagic	Pelagic		Mangroves	Mangroves, Reefs	Hard bottoms, Reefs	
Gag	Pelagic	Pelagic		SAV	Hard bottoms, Reefs, SAV	Hard bottoms, Reefs	

Common name	Eggs	Larvae	Post-larvae	Early Juveniles	Late juveniles	Adults	Spawning adults
Scamp	Pelagic	Pelagic		Hard bottoms, Mangroves, Reefs	Hard bottoms, Mangroves, Reefs	Hard bottoms, Reefs	Reefs, Shelf edge/slope
Yellowfin grouper				SAV	Hard bottoms, SAV	Hard bottoms, Reefs	Hard bottoms

Reef Fish

The Reef Fish FMP currently encompasses 42 species (Table 5.2.3.2-2). Stock assessments have been conducted on 11 species: red snapper (SEDAR 7, 2005), vermilion snapper (SEDAR 9 2006a), yellowtail snapper (SEDAR 3 2003), gray triggerfish (SEDAR 9 2006b), greater amberjack (SEDAR 9 2006c), hogfish (SEDAR 6 2004a), red grouper (SEDAR 12 2007), gag (SEFSC 2007a), yellowedge grouper (Cass-Calay and Bahnick 2002), and goliath grouper (SEDAR 6, 2004b). A review of the Nassau grouper's stock status was conducted by Eklund (1994), and updated estimates of generation times were developed by Legault and Eklund (1998).

Of the 11 species for which stock assessments have been conducted, the 2006 Report to Congress on the Status of the U.S. Fisheries (NOAA Fisheries Service 2007) classifies two as overfished (greater amberjack and red snapper), and five as undergoing overfishing (red snapper, red grouper, gag, gray triggerfish, and greater amberjack). Recent assessment for vermilion snapper (SEDAR 9 2006a) and red grouper (SEDAR 12 2007) indicate these species are not overfished and are not undergoing overfishing. Recent assessments for greater amberjack (SEDAR 9 2006c), gray triggerfish (SEDAR 9 2006b), and gag (SEFSC 2007a) suggest these species are experiencing overfishing, and stock recovery for greater amberjack is occurring slower than anticipated. The overfished status for gag and gray triggerfish is currently undefined. However, once the Council approves status determination criteria, gray triggerfish will be overfished and gag will not be overfished. The Council is developing Amendments 30A and 30B to the Reef Fish FMP to address overfishing for gag, gray triggerfish, and greater amberjack. Amendment 30A will also revise the greater amberjack rebuilding plan and establish a gray triggerfish rebuilding plan. Many of the stock assessments and stock assessment reviews can be found on the Council (www.gulfcouncil.org) and SEDAR (www.sefsc.noaa.gov/sedar) Websites.

Coastal Migratory Pelagics

King Mackerel

Although the Gulf group king mackerel stock is no longer considered as overfished or undergoing overfishing, the current spawning stock biomass (SS) is below SS_{MSY}. However, $F_{current}$ is below F_{MSY}; consequently the stock is expected to continue to recover under the present management strategy. Although the current TAC is set at 10.2 million pounds, catches in the most recent years have approximated catches at the ABC range for

OY (7.0 mp to 8.0 mp). Consequently, further rebuilding is expected to the target SS_{OY} level in the future.

Spanish Mackerel

Gulf group Spanish mackerel was assessed in 1999 using data through the 1997 fishing year. Based on the Council's proposed definitions for overfishing and the overfished condition for Gulf group Spanish mackerel, the stock is not considered as either overfished or undergoing overfishing (MSAP 2001a). Recent catch levels are less than half of the recommended TAC under the OY target of $F_{40\%}$ SPR. Furthermore, SSBcurrent is above SSBmsy.

Dolphin

Prager (2000) assessed the dolphin stocks in the Gulf of Mexico, South Atlantic, and Caribbean as one stock. He concluded that F_{1997} to Fmsy was approximately 50 percent, and B_{1998} to Bmsy was approximately 156 percent. Consequently, the stock was neither undergoing overfishing nor overfished. Furthermore, MSY was estimated at approximately 27 million pounds per year, and average annual catches for the last 5 years were approximately 16 million pounds. Thus, there is little chance that the stock would become overfished unless fishing mortality drastically increased.

Cobia

MSAP (2001b) and Williams (2001) observed that F_{2000} was estimated at 0.67 and there was a 40 percent chance that F_{2000} was greater than F_{MSY}. Biomass in 2000 was estimated at 1.33 and there was a 30 percent chance that B_{2000} was less MSST, defined as 70 percent of B_{MSY}. Consequently, under the Council's proposed status determination criteria, cobia would not be considered as overfished or undergoing overfishing. Furthermore, catches in recent years have been approximately 1.1 to 1.2 million pounds and below the estimated MSY of 1.5 million pounds. Additionally, these recent catches have been below NOAA Fisheries' recommended OY catch of 75 percent of MSY. Thus, it is expected that if present catch levels continue the stock will continue to remain healthy.

Cero, Bluefish, and Little Tunny

Included in the CMP FMU, no stock status criteria or determinations have been made.

Stone Crab

Landings, in pounds of claws on a fishing-season basis, have varied without trend since 1989-90. Peak landings were 3.5 million pounds statewide in Florida in the 1997-98 fishing season. Statewide landings for 2004-05 were 3.0 million pounds of claws.

Since the 1962-63 fishing season (the first year with an estimate of the number of traps in the fishery), the number of traps in the fishery has increased more than a hundred-fold – from 15,000 traps in the 1962-63 season to 1.6 million traps in the 2001-02 season. In a physical count of traps conducted in the 1998-99 fishing season, FWC employees found 1.4 million traps, which was twice the number that was estimated in 1992-93. As a response to the rapidly increasing number of traps in the fishery, the legislature in 2000

approved the stone crab trap limitation program, which was implemented in October 2002. The number of commercial trips also increased from 19,000 in the 1985-86 season (the first season with trip information available) to a maximum of 38,000 trips in the 1996-97 season and then declined afterwards.

The status of the stock is best indicated by the stable landings after 1989-90. The three-fold increase in the number of traps since then suggests that the current level of landings is all that can be harvested under current environmental conditions, regulations, and fishery practices and that the fishery is overfishing. Recruitment does not show any decline over the time series. These conclusions were the same as those from the 1997 and 2001 assessments. The stone crab fishery may be resilient because most female stone crabs spawn one or more times before their claws reach legal size, because some crabs survive declawing, and because the fishing season is closed during the principal spawning season. However, the fishery continues to have too many traps in the water. Further evidence of excess traps is the low catch-per-trap level over a very wide range of numbers of traps. For the past decade (1995-96 to 2004-05 fishing seasons), the Gulf coast fishers have declawed approximately 10.5 million crabs during each seven-month fishing season.

Spiny Lobster

This section summarizes the "assessment of spiny lobster, *Panulirus argus*, in the Southeast United States" prepared by the SEDAR 08 U.S. Spiny Lobster Stock Assessment Panel. By necessity, this summary also includes material from the Data Workshop Report.

The Stock Assessment Workshop was held March 15-17, 2005 in Marathon, Florida. The panel members chose two assessment models: a simple, modified DeLury model and a statistical catch-at-age model (Integrated Catch-at-Age). The age-structured model was the base model and the DeLury model was a check for consistency. The DeLury model used numbers of fish and effort by fishing year extended back to the 1978-79 fishing year. Both models used fishery-dependent and fishery-independent tuning indices. Sensitivity runs included running the age-structured model with two lipofuscin growth curves and with two alternative natural mortality rates. Retrospective analysis compared patterns in fishing mortality rates, recruitment, and population sizes in terminal years from 1997-98 to 2002-03 to the base run results.

Recruitment of lobsters one year after settlement has varied over the time series. The spawning biomass in Florida has increased over time especially in the three most recent fishing years. Fishing mortality rates have varied without trend until the recent drop in fishing mortality after 2000. Older lobsters appear to be less available to the fishery as reflected in the dome-shaped selectivity curve. Both assessment models interpreted the lower landings after the 1990-00 fishing year as decreased effort. The DeLury model estimated a lower population size with correspondingly higher fishing mortality rates than did ICA but when the DeLury was adjusted for selectivity, the results were similar.

The retrospective analyses indicated that fishing mortality rates from ICA were initially underestimated by an average of 37 percent.

Amendment 6 of the Spiny Lobster FMP defined overfishing as fishing at a rate in excess of that associated with a static SPR value of 20 percent (F2005). With the current life history values and fishery practices, the fishing mortality rate on fully recruited lobsters (age-3) at a static SPR of 20 percent was 0.49 per year. The spiny lobster fishery in Southeast United States has fluctuated at SPR values around the 20 percent objective until the three most recent years and was deemed to not be overfishing because the fishing mortality rate on age-3 in 2003-04 (0.26 per year) was below the Council's Fmsy proxy of F20 percent. Even when the fishing mortality rate was adjusted for retrospective bias (0.36 per year), the fishing mortality rate in 2003-04 was still below the Council's management objective. Without a Caribbean-wide stock assessment, we were unable to determine the status of the stock with regard to the spawning biomass at MSY (Bmsy) or the Minimum Stock Size Threshold.

Red Drum

The 1987 Stock Assessment Panel report recommended that acceptable biological catch (ABC) be set at zero for the EEZ and that the states increase the escapement rate from the estuaries to 20 percent. The 1989 SEFSC Stock Assessment report indicated the SSBR would likely decline to 13 percent. The 1989 Stock Assessment Panel report recommended ABC for the EEZ be maintained at zero, and that the states increase escapement to 30 percent.

During 1991, the Red Drum Stock Assessment Panel (RDSAP) reviewed stock assessments prepared by NOAA Fisheries, the Louisiana Department of Wildlife and Fisheries, and the State of Florida. The RDSAP recommendation was that ABC be set at zero. The Council recommended to NOAA Fisheries that total allowable catch (TAC) be zero for 1992, and that a more comprehensive assessment of a SSBR level be provided in 1992.

The stock assessment for red drum is very uncertain, and the Red Drum Stock Assessment Panel (RDSAP) could not reach a firm conclusion on the Gulf-wide status of the red drum resource (RDSAP 2000). The RDSAP made several assessment runs with a variety of assumptions, and obtained results that ranged from overfished to not overfished (Michael Murphy, FWRI, pers. comm.). In general, however, most assessment runs showed an overfished condition. In contrast, red drum assessments by the Gulf of Mexico states show the red drum resource is not overfished (Michael Murphy, FWRI, pers. comm.).

Table 5.2.3.2-2 Species of the reef fish FMP. Species in bold have had stock assessments. *Deep-water groupers (Note: if the shallow-water grouper quota is filled, then scamp are considered a deep-water grouper) **Protected groupers

Common Name	Scientific Name	Stock Status
	Balistidae--Triggerfishes	
Gray triggerfish	***Balistes capriscus***	**Overfished, overfishing**
	Carangidae--Jacks	
Greater amberjack	***Seriola dumerili***	**Overfished, overfishing**
Lesser amberjack	*Seriola fasciata*	Unknown
Almaco jack	*Seriola rivoliana*	Unknown
Banded rudderfish	*Seriola zonata*	Unknown
	Labridae--Wrasses	
Hogfish	***Lachnolaimus maximus***	**Unknown**
	Lutjanidae--Snappers	
Queen snapper	*Etelis oculatus*	Unknown
Mutton snapper	*Lutjanus analis*	Unknown
Schoolmaster	*Lutjanus apodus*	Unknown
Blackfin snapper	*Lutjanus buccanella*	Unknown
Red snapper	***Lutjanus campechanus***	**Overfished, overfishing**
Cubera snapper	*Lutjanus cyanopterus*	Unknown
Gray (mangrove) snapper	*Lutjanus griseus*	Unknown
Dog snapper	*Lutjanus jocu*	Unknown
Mahogany snapper	*Lutjanus mahogoni*	Unknown
Lane snapper	*Lutjanus synagris*	Unknown
Silk snapper	*Lutjanus vivanus*	Unknown
Yellowtail snapper	***Ocyurus chrysurus***	**Not overfished, not overfishing**
Wenchman	*Pristipomoides aquilonaris*	Unknown
Vermilion snapper	***Rhomboplites aurorubens***	**Not overfished, not overfishing**
	Malacanthidae--Tilefishes	
Goldface tilefish	*Caulolatilus chrysops*	Unknown
Blackline tilefish	*Caulolatilus cyanops*	Unknown
Anchor tilefish	*Caulolatilus intermedius*	Unknown
Blueline tilefish	*Caulolatilus microps*	Unknown
(Golden) Tilefish	*Lopholatilus chamaeleonticeps*	Unknown
	Serranidae--Groupers	
Dwarf sand perch	*Diplectrum bivittatum*	Unknown
Sand perch	*Diplectrum formosum*	Unknown
Rock hind	*Epinephelus adscensionis*	Unknown
Yellowfin grouper	*Mycteroperca venenosa*	Unknown
Scamp	*Mycteroperca phenax*	Unknown
Red hind	*Epinephelus guttatus*	Unknown
****Goliath grouper**	***Epinephelus itajara***	**Overfished, not overfishing**
****Nassau grouper**	***Epinephelus striatus***	**Overfished, not overfishing**
Red grouper	***Epinephelus morio***	**Not overfished, not overfishing**
Gag	***Mycteroperca microlepis***	**Not overfished, overfishing**
Yellowmouth grouper	*Mycteroperca interstitialis*	Unknown
Black grouper	*Mycteroperca bonaci*	Unknown
***Yellowedge grouper**	***Epinephelus flavolimbatus***	**Unknown**
*Snowy grouper	*Epinephelus niveatus*	Unknown
*Warsaw grouper	*Epinephelus nigritus*	Unknown
*Misty grouper	*Epinephelus mystacinus*	Unknown
*Speckled hind	*Epinephelus drummondhayi*	Unknown

5.2.3.2 Highly Migratory Species

The most recent assessment of North and South Atlantic swordfish stocks was conducted in 2002. The North Atlantic swordfish biomass may have exceeded the B_{MSY} level, while the South Atlantic swordfish stock could not obtain reliable results due to inconsistencies in the available CPUE data. The 2002 assessment of Atlantic bluefin tuna indicated the fishing mortality rate on the resource exceeds F_{MSY} and the SSB is below B_{MSY}, thus the stock is overfished, and overfishing continues to occur. Bigeye tuna were last assessed in 2004. The stock was found to be overfished with overfishing occurring. Yellowfin tuna were last assessed in 2003 and was found to be approaching an overfished condition. Albacore tuna were last assessed in 2003 and found to be overfished and undergoing overfishing. Skipjack tuna were last assessed in 1999. However, due to life history characteristics, including continuous recruitment throughout the year, it is extremely difficult to conduct a standardized assessment. Therefore, the status of this stock is unknown.

The last stock assessment of blue marlin was conducted in 2000. Blue marlin are at approximately 40 percent of B_{MSY} and overfishing has occurred for the last 10 – 15 years. The most recent stock assessments of white marlin (1996, 2000, and 2002) all indicated that the biomass of white marlin has been below B_{MSY} for more than two decades and the stock is overfished. Based on a 2001 assessment, it is unknown if the sailfish stocks are undergoing overfishing or if the stocks are overfished. Both large coastal sharks and small coastal sharks were assessed in 2002. Overfishing was occurring in both complexes, while only the large coastal shark complex was found to be overfished.

5.2.3.3 Marine Mammals and Protected Species

There are 28 different species of marine mammals that may occur in the Gulf. All 28 species are protected under the MMPA and six are also listed as endangered under the ESA (sperm, sei, fin, blue, humpback and North Atlantic right whales). Other species protected under the ESA occurring in the Gulf include five sea turtle species (Kemp's Ridley, loggerhead, green, leatherback, and hawksbill); two fish species (Gulf sturgeon and smalltooth sawfish), and two *Acropora* coral species (elkhorn [*Acropora palmata*] and staghorn [*A. cervicornis*]). For information on these protected species in the Gulf, refer to the final EIS to the Council's Generic EFH amendment (GMFMC 2004) and the February 2005 ESA biological opinion on the reef fish fishery. Marine mammal Stock Assessment Reports and additional information is also available on the NOAA Fisheries Service Office of Protected Species website: http://www.nmfs.noaa.gov/pr/species/.

There is a resident population of female sperm whales in the Gulf of Mexico, and whales with calves are sighted frequently. However, sperm whales are considered to commonly occur beyond shelf edge (> 200 m). Typically, no endangered species of whales occur in the nearshore waters over the continental shelf of the Gulf of Mexico. Occasionally, North Atlantic right whales and humpback whales may be found in nearshore waters of the Gulf of Mexico, usually during the winter season, but sightings of these species are relatively uncommon.

Sperm whale pods have been observed throughout the GOM from the upper continental slope near the 100-m isobath to the seaward extent of the United States EEZ and beyond, from sightings data collected from NOAA cruises from 1991 to 2000 (Roden and Mullin 2000, Baumgartner et al. 2001, Burks et al. 2001). Based on NOAA surveys, opportunistic sightings, whaling catches, and stranding records, sperm whales in the GOM occur year-round. Sperm whales appear to favor water depths of about 1,000 m and appear to be concentrated in at least two geographic regions of the Northern GOM: an area off the Dry Tortugas and offshore of the Mississippi River delta (Maze-Foley and Mullin 2006); however, distribution also appears to be influenced by occurrence and movement of cyclonic/anti-cyclonic currents in the GOM. Davis et al. (2000a) noted the presence of a resident, breeding population of endangered sperm whales within 50 km of the Mississippi River Delta and suggested that this area may be essential habitat for sperm whales. The Southeast United States Marine Mammal Stranding Network received reports of 17 sperm whales that stranded along the GOM coastline from 1987 to 2003 in areas ranging from Pinellas County, Florida, to Matagorda County, Texas. The GOM sperm whale abundance has most recently been estimated at 1,349 whales (CV = 0.23) (Mullin and Fulling 2003), calculated from an average of estimates from surveys conducted between 1996 and 2001.

The GOM stock is comprised of mostly females and calves, although large mature bulls have been recently sighted in the GOM. Based on seasonal aerial surveys, sperm whales are present in the northern GOM in all seasons, but sightings in the northern GOM are more common during the summer months (Mullin et al. 1991, Davis et al. 2000a). Based on recent survey efforts, sperm whales concentrations are regularly sighted, and the boundaries of these areas of concentration in the Northern GOM appear to be approximately 86.5^{o}W to 90.0^{o}W, north of 27.0^{o}N (Mullin 2002), and off southern Florida in an area approximately 86.5^{o}W to 85.5^{o}W, 24.0^{o}N to 26.0^{o}N (Mullin 2002); however, sperm whales have been reported throughout the GOM in waters greater than 200 m.

Bottlenose dolphins, Atlantic spotted dolphins, and Risso's dolphins are the only dolphins in the Gulf that commonly occur in estuarine waters to continental shelf edge (0-200 m). Bottlenose dolphins are the most widespread and common cetaceans of the coastal Gulf waters. They inhabit the Gulf of Mexico year-round and are the most commonly observed dolphin in nearshore waters. Atlantic spotted dolphins prefer tropical to warm-temperate waters over the continental shelf, edge, and upper reaches of the slope. Risso's dolphins are typically found around the continental shelf edge and steep upper sections of the slope (>100 m depths).

The leatherback is the most abundant sea turtle in waters over the northern GOM continental slope (Mullin and Hoggard 2000). Leatherbacks appear to spatially use both continental shelf and slope habitats in the GOM (Fritts et al. 1983, Collard 1990), but primarily utilize pelagic waters > 200 m (Davis and Fargion 1996) throughout the northern GOM. Recent surveys suggest that the region from the Mississippi Canyon to DeSoto Canyon, especially near the shelf edge, appears to be an important habitat for

leatherbacks (Mullin and Hoggard 2000). Surveys of sea turtles in the eastern GOM reported densities of 0.0026 individuals/km^2 (95 percent CI = 0.0004 - 0.0140) in 0-10 fathoms and 0.0029 individuals/km^2 (95 percent CI = 0.0015 - 0.0057) in 10-40 fathoms (Epperly et al. 2002). Leatherbacks are year-round inhabitants in the GOM with frequent sightings during both summer and winter (Mullin and Hoggard 2000). Temporal variability and abundance suggest that specific areas may be important to this species, either seasonally or for short periods of time.

Green sea turtles are found throughout the GOM. They occur in small numbers over seagrass beds along the south of Texas and the Florida GOM coast. Areas known as important feeding areas include the Homosassa River, Crystal River, and Cedar Key, Florida, and seagrass meadows and algae-laden jetties along the Texas coast. Sea turtle surveys in the eastern GOM have reported densities of 0.0021 individuals/km^2 (95 percent CI = 0.0006 - 0.0075) in 0-10 fathoms and 0.0137 individuals/km^2 (95 percent CI = 0.0060 - 0.0317) in 10-40 fathoms (Epperly et al. 2002).

The nearshore waters of the GOM are believed to provide important developmental habitat for juvenile Kemp's ridley sea turtles. Ogren (1989) suggests that the GOM coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern GOM. This species generally remains within the 50-m isobath of coastal areas throughout the GOM. Surveys of sea turtles in the eastern GOM reported densities of 0.0079 individuals/km^2 (95 percent CI = 0.0030 - 0.0207) in 0-10 fathoms and 0.0011 individuals/km^2 (95 percent CI = 0.0004 - 0.0035) in 10-40 fathoms (Epperly et al. 2002). Stomach contents from Kemp's ridleys also indicate a nearshore distribution by their prey distribution which is consistent with other reported density estimates of 0.065 turtles per km^2 in 0-10 fathoms compared to a decrease of 0.013 turtles per km^2 in 10-40 fathoms (Epperly et al. 2002).

The nearshore waters of the GOM are believed to provide important developmental habitat for loggerhead sea turtles. Loggerhead nesting along the GOM coast occurs primarily along the Florida Panhandle, although some nesting has been reported from Texas through Alabama as well (NOAA Fisheries Service and FWS 1991). Surveys of sea turtles in the eastern GOM resulted in reported densities of 0.0532 individuals/km^2 (95 percent CI = 0.0295 - 0.0961) in 0-10 fathoms and 0.0452 individuals/km^2 (95 percent CI = 0.0233 - 0.0880) in 10-40 fathoms (Epperly et al. 2002). Loggerhead abundance does not appear to be significantly different between winter and summer months over shelf waters in the GOM (Davis et al. 2000b). Although loggerheads are widely distributed during both summer and winter, their abundance in surface waters over the continental slope may be greater during winter than in summer (Mullin and Hoggard 2000), and many sightings occurred near the 100-m isobath (Davis et al. 2000b). Sightings of loggerheads in waters over the continental slope suggest that they may be in transit through these waters to distant foraging sites or seeking warmer waters during the winter. The majority of sightings have occurred in waters over the continental shelf, although many sightings have been reported over the continental slope.

In addition to some distribution over the slope waters, surface sightings of this species have also been made over the outer slope, approaching the 2,000-m isobath. Loggerheads found in deep waters may be traveling to distant nesting beaches, traveling between forage sites on distant and disjunct areas of the continental shelf, or seeking warmer waters during winter (Davis et al. 2000b).

5.2.3.4 Menhaden and Other Bait Fishes

Approximately 50 species of baitfish exist worldwide (FWRI 2000). These fishes are important food source for large predators and represent an integral part of the marine food web. They are used primarily for the production of fish oils and fish meal, pet food, fertilizer, and recreational and commercial fishing bait. In the Gulf of Mexico, several important species of baitfish exist, including: Gulf menhaden (*Brevoortia patronus*), Atlantic thread herring (*Opisthonema oglinum)*, Spanish sardines (*Sardinella aurita*), round scad (*Decapterus punctatus*), and bigeye scad (*Selar crumenophthalmus*). Of these five species, Gulf menhaden account for greater than 99 percent of the Gulf of Mexico baitfish landings. A similar species, Atlantic menhaden (*Brevoortia tyrannus*), is also landed in significant, although lesser quantities off several U.S Mid-Atlantic States. Figure 5.2.3.4-1 summarizes trends in Gulf menhaden landings and value from 1950-2006. Landings increased from 1950 through the mid-1980s. Beginning in 1984, landings began to decline. Landings during the last five years were approximately 50 percent less than landings during 1983-1987. The most recent stock assessment for Gulf menhaden was conducted by Vaughn et al. (2007). The assessment indicated that Gulf menhaden fishing mortality rates (F) and spawning stock biomass were between target and limit biological reference points, indicating the stock was neither undergoing overfishing or overfished (Vaughn et al. 2006). However, the assessment did express possible concerns regarding a recent increase in F and decrease in population fecundity.

The Atlantic menhaden stock is neither overfished, nor undergoing overfishing (AMTC 2006). The F in 2005 was well below the overfishing limit (56 percent of F_{limit}) and stock fecundity was well above the overfished threshold (317 percent of fecundity limit).

Gulf menhaden are obligate filter feeders; they strain plankton and detritus (Friedland 1955). They are an important food source for many fishes, sea birds, and marine mammals (Ahrenholz 1991). Gulf menhaden migrate inshore in early spring and offshore in late fall (Roithmayr and Waller 1963). Spawning occurs during fall and winter, peaking in December and January (Lewis and Roithmayr 1981). Ninety-percent of all harvested fish are 1-2 years old, but they may live to be 6 years or older. Gulf menhaden are fully mature by age-2.

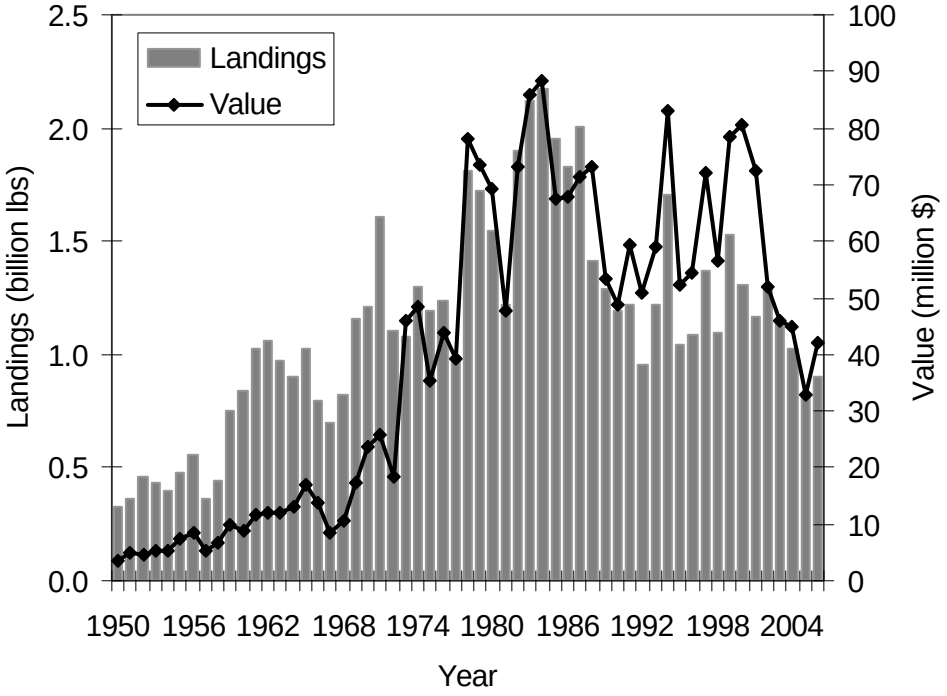

Figure 5.2.3.4-1. Trends in Gulf Menhaden landings and value, 1950-2006.

5.3 Description of the Economic and Social Environment

5.3.1 Commercial Fishery

The annual dockside value of the Gulf of Mexico commercial production has tended to fluctuate between $600 and $800 million, though occasionally it has reached $900 million. Product comes from both state and federal waters and includes both product for human consumption (e.g., reef fish and shrimp) and industrial use (e.g., menhaden). The most valuable commercially harvested species is shrimp, generally accounting for well in excess of one-half of the total. Other commercially important species (groups) include stone crab, blue crab, oysters, spiny lobsters, reef fish, coastal pelagics, and menhaden.

Many species (families) are managed under the auspices of the Gulf of Mexico Fishery Management Council. Management of other species is under the purview of each of the respective Gulf states. This section of the amendment briefly provides a description of the economic and social environment of some of the more economically relevant species,

In total, there are seven Gulf of Mexico Fishery Management Council plans. They are: (1) The *Red Drum Fishery Management Plan* (RDFMP) which was implemented in December 1986, (2) *The Fishery Management Plan* for the Reef Fish Resources of the Gulf of Mexico, which was approved in June 1983, (3) The fishery management plan for coastal migratory pelagic fisheries (*CMP FMP*), which was prepared cooperatively by the Gulf of Mexico and South Atlantic Fishery Management Councils, was implemented in February 1983, (4) The Fishery Management Plan for the Shrimp Fishery of the Gulf of

Mexico, U.S. Waters, which was implemented in 1981, (5) *The Fishery Management Plan for the Stone Crab Fishery of the Gulf of Mexico (SCFMP)*, originally developed in response to competing gear use between stone crab and shrimp fishermen, was implemented in 1979, (6) The *Spiny Lobster Fishery Management Plan for the Gulf and South Atlantic (SLFMP)*, which was implemented in July 1982, and (7) The *Fishery Management Plan for Corals and Coral Reefs (CCRFMP)* was submitted for Secretarial approval in April 1982 and was implemented in 1984. The GMFMC is proposing to amend five of these plans through this generic amendment. Fishery management plans for coral and shrimp are not being amended, because regulations already exist for live rock and it is impractical that shrimp will be cultured offshore given the success of existing onshore aquaculture facilities.

In 2007, there were a total of 945 federal reef fish permits and 1514 coastal migratory pelagic permits (Table 5.3.1-1). Other commercial fisheries currently permitted include: shrimp, red snapper, shark, spiny lobster, and swordfish. There are also permits required for charter and other recreational for-hire vessels in the reef fish and coastal pelagic fishery.

Table 5.3.1-1. Federal Permit Type as of October 2007 (NOAA Fisheries Service)

Type of Permit	Number
Shrimp	1848
Commercial Migratory Pelagic	1514
Reef Fish	945
Red Snapper	612
Commercial Spiny Lobster (non-Florida/tailing)	132/299
Charter/Headboat for Coastal Pelagics	1348
Charter/Headboat for Reef Fish	1356
Swordfish (directed/incidental/handgear)	180/80/82
Shark (directed/incidental)	132/283

Given that the majority of offshore production, at least in the near future, will likely be finfish species, with cobia, red drum, and snapper species being prime candidates, the analysis focuses primarily on management plans associated with these species. However, some attention is also devoted to species in the remaining two management plans.

A full description of all fisheries associated with Council FMPs is provided in detail in the EIS for the Generic Essential Fish Habitat Amendment (GMFMC 2004), while Section 5.3.3 describes Gulf of Mexico fishing communities; these sections are incorporated herein by reference. Much of the language used in the description of the fisheries was taken from previous Gulf of Mexico plan amendments.

5.3.1.1 Red Drum

The Red Drum Fishery Management Plan (RDFMP), when implemented in December, 1986, prohibited the directed commercial harvest from the EEZ for 1987 but did provide for an incidental catch allowance for commercial net and shrimp fishermen. The Gulf of Mexico Fishery Management Council prepared Amendment 1 to the RDFMP which was implemented in October, 1987. The amendment continued the prohibition of a directed

commercial EEZ fishery. Since implementation of Amendment 2 in 1988, retention and possession of red drum from the EEZ has been prohibited.

While the commercial harvest of red drum in the EEZ is prohibited, only Mississippi allows commercial harvests from state waters. Since 2000, production from state waters has averaged 25 thousand pounds annually with an associated dockside value of about $35 thousand. The states of Texas and Florida stock red drum fingerlings and fry into their coastal waters from their hatcheries in stock restoration projects. Red drum are a likely candidate for offshore aquaculture because of their rapid growth rate and existing production in land-based U.S. hatcheries.

5.3.1.2 Reef Fish[18]

5.3.1.2.1 Permits and Landings

The Reef Fish FMP for the GOM was established in November 1984 to help rebuild declining reef fish stocks. In 1990, Amendment 1, to the Reef Fish FMP, established a commercial reef fish permit. Anyone wishing to harvest any reef fish as part of the commercial fishery or possess more than a bag limit was required to hold a valid reef fish permit for their vessel (50 CFR 622.4(a)(2)(v)). Amendment 4 was implemented in 1992 and created a three-year moratorium on the issuance of new commercial reef fish permits. Amendment 9 extended the moratorium until December 31, 1995. Amendment 11 further extended the moratorium until December 31, 2000. Amendment 17 extended the commercial reef fish permit moratorium for another 5 years, through December 31, 2005. Amendment 24, implemented in August, 2005, established a permanent limited access system. Of particular relevance, the recently implemented Amendment 26 established an IFQ program for the red snapper fishery.

Reef fish permits are required to commercially harvest reef fish species. Reef fish that are harvested may only be sold to buyers holding a valid permit to purchase reef fish. The holders of the harvesting permits define the universe of vessels that may legally harvest reef fish to be sold commercially.

The number of commercial reef fish permits has declined due to non-renewal of permits from approximately 2,200 in 1992 to approximately 1,145 as of July 2004 (GMFMC 2004c). Permit data indicate that 908 of those permits were assigned to vessels that were only permitted to fish reef fish commercially. The remaining 237 permits were assigned to vessels that can fish reef fish as commercial vessels or as charter vessels or headboats.

The state of residence of each of the permit holders and the number of permits held are presented in Table 5.3.1.2.1-1. Information in that table shows that 933 of the permits owners (81.5 percent) list Florida as owner's address. Texas is listed as the owner's state on 80 permits (7 percent). Louisiana is listed as the owner's state on 61 (5.3 percent)

18 Much of the discussion for this section is taken from Amendment 18A to the Reef Fish FMP.

permits, Alabama on 37 (3.2 percent) permits, Mississippi on 16 (1.4 percent) permits, and the other states account for the 18 (1.6 percent) remaining permits.

Table 5.3.1.2.1-1: Number of Commercial Reef Fish Permits for the Gulf of Mexico by Owner's State of Residence

Owners' State	**Commercial Permit Only**	**Commercial and Charter/Headboat Permits**	Total
FL	736	197	933
TX	57	23	80
LA	55	6	61
AL	29	8	37
MS	16		16
DE	1		1
GA	3	1	4
IN	1		1
MA	1		1
MD		1	1
MO	1		1
NJ	2		2
NY	3		3
OH	1		1
SC	1		1
TN	1	1	2
Total	**908**	**237**	**1,145**

Source: NOAA Fisheries Service Reef Fish Permit Database, July 2004.

Reef fish commercial fishermen that may be directly impacted by successful offshore aquaculture of reef fish species are those approximately 1,056 individuals that currently hold a commercial reef fish permit. Other fishermen could be indirectly impacted if (a) reef fish fishermen change their seasonal fishing patterns and increase effort for other species or (b) there is strong cross-price flexibility between reef fish and other harvested species in the Gulf.

Gulf-wide average commercial harvests and ex-vessel values by species group are presented in Table 5.3.1.2.1-2. Averages were computed for the 1995-2003 period. Landings are expressed in pounds whole weight. Data were obtained from the NOAA Fisheries Service web site maintained by the Fisheries Statistics and Economics Division. Shallow water groupers and snappers constituted more than 85 percent of the commercial landings for the period considered. Total yearly reef fish ex-vessel values were, on average, in excess of $40 million.

Table 5.3.1.2.1-2: Gulf-wide Average Commercial Landings and Ex-Vessel Values by Species Group (1995-2003)

SPECIES GROUP	LANDINGS		VALUE	
	(lbs)	(%)	($)	(%)
Shallow Water Groupers	9,223,362	44.94	18,724,722	46.61
Snappers	8,694,078	42.36	17,088,708	42.54
Deep Water Groupers	1,401,087	6.83	3,103,882	7.73
Amberjack & Other Reef Fish	1,205,672	5.87	1,258,074	3.13
TOTAL	20,524,199	100.00	40,175,386	100.00

Source: NOAA Fisheries Service Fishery Statistics (http://www.st.nmfs.gov/st1/index.html).

Data for the 9-year period discussed in this section indicated that, red, vermilion and yellowtail snappers, gag and red groupers and, greater amberjack accounted for most of the commercial reef fish landings. Together, these species represented 85 percent of total reef fish landings. Gulf-wide average commercial landings by reef fish species, ex-vessel values, nominal and real prices are presented in Table 5.3.1.2.1-3. Red grouper, the species with the largest average yearly landings, accounted for 30 percent of the Gulf reef fish landings. Red snapper and gag, which are second and third in poundage landed, accounted for 22 percent and 12 percent of the landings, respectively.

The vast majority of the harvest of several reef fish species was from the Florida west coast. For example, over 99 percent of the red grouper, 96 percent of the black grouper, and 80.5 percent of the scamp harvested were attributed to the Florida west coast according to data from the NOAA web site. On average, red snapper was the most expensive species in the snapper complex. Nominal and real red snapper prices were $2.06 and $2.14 per pound, respectively. At $2.48 per pound, the highest reef fish average real price was for scamp. The average real price for red grouper, the species with the highest average harvest, was $1.93 per pound.

Table 5.3.1.2.1-3: Gulf-wide Average Commercial Landings, Values, and Ex-Vessel Prices by Species (1995-2003).

Snappers	Landings (lbs)	Nominal Value($)	Price ($/lb) Nominal	Price ($/lb) Real
Red Snapper	4,491,230	9,258,348	2.06	2.14
Vermilion Snapper	1,916,805	3,517,124	1.83	1.91
Yellowtail Snapper	1,458,229	2,880,761	1.98	2.05
Gray Snapper	364,122	617,822	1.70	1.76
Mutton Snapper	205,909	359,718	1.75	1.81
Silk Snapper	110,769	226,429	2.04	2.12
Other	147,013	228,505	1.55	1.61
Total	8,694,078	17,088,708	---	---
Deep Water Groupers				
Yellowedge Grouper	933,542	2,206,240	2.36	2.46
Snowy Grouper	195,850	392,642	2.00	2.08
Warsaw Grouper	139,754	248,610	1.78	1.85
Other	131,942	256,390	1.94	2.02
Total	1,401,087	3,103,882	---	---
Shallow Water Groupers				
Red Grouper	6,129,500	11,409,603	1.86	1.93
Gag	2,416,492	5,751,162	2.38	2.47
Black Grouper	359,879	814,534	2.26	2.35
Scamp	301,630	720,169	2.39	2.48
Other	15,861	29,254	1.84	1.92
Total	9,223,362	18,724,722	---	---
Other Reef Fish				
Greater Amberjack	1,025,994	1,037,913	1.01	1.05
Other	179,678	220,161	1.23	1.27
Total	1,205,672	1,258,074	---	---

5.3.1.2.2 Vessel Characteristics

In terms of 2001-2003 annual averages from logbook-reported data, 1,050 vessels landed 19.2 MP gutted weight (GW) of Gulf reef fish with a real ex-vessel value of $44.6 million. Median reef fish landings were 5,705 pounds per vessel. The median vessel was 37 feet long, derived 98 percent of its gross revenues from reef fish harvests, had 275 to 300 horsepower engines, took 12 trips per year, and spent about 31 days at sea annually.

Averages computed for vessels using longlines indicated that 166 longliners harvested 6.5 MP GW of reef fish and had gross revenues estimated at $15.5 million. The median vessel length for this fleet was 43 to 45 feet, had 3-person crews (including the captain) and 228 to 240 horsepower engines, and spent between 113 to 121 days at sea annually. Median longline vessels took 14 trips per year. The annual gross revenue per vessel for all reef fish landed was between $96,000 and $102,000.

An average of 899 vessels using handlines took 15,613 trips a year and spent 43,463 days at sea annually. The average annual reef fish harvest of the handline fleet was 11.6 mp GW. The median handline vessel was 35 to 36 feet long, had 280 to 300 horsepower engines, had 2 person crews, and spent 33 to 35 days away from port. Gross revenues were between $12,000 and $13,000 per vessel.

Waters (2002) provided participation rates by gear and state and reported that of the vessels with commercial reef fish permits, 782 vessels in Florida and 207 in other Gulf States indicated they landed reef fish using vertical lines in 2000. For the longline sector, 155 vessels in Florida and 33 in other Gulf States indicated landing reef fish using this gear in 2000. An additional 55 vessels, all of which are in Florida, reported landing reef fish using fish traps.

Waters (1996) reported results from a survey of the GOM commercial reef fish fishery that divided the vessels into high volume and low volume depending on whether or not they landed enough pounds to be in the top 75 percent of all vessels with a particular gear type in the fishery. The survey included vessels that reported using multiple types of gear. "Fishermen that primarily used fish traps for reef fishes tended to cite the use of fish traps, stone crab traps, rods and reels and gill nets, among others. Respondents with vertical hooks and lines in the eastern Gulf used bandit reels, electric reels and rods and reels. Respondents that primarily used bottom longlines for reef fishes also tended to cite experience with vertical hook and line gear" (Waters 1996). The survey asked vessel owners to report on their two most important kinds of trips for reef fish, even if non-reef fish alternative contributed more to the annual revenues of the boat. Comparisons were drawn between high volume and low volume boats within each category and between those in the northern Gulf and the eastern Gulf.

In the northern Gulf, catches differed by gear with vessels using vertical lines catching primarily snapper (red and vermilion) and vessels using bottom longlines catching primarily yellowedge grouper. Vessels in the eastern Gulf primarily caught groupers using bottom longlines, vertical lines, and fish traps. The vessels with vertical lines in the

northern Gulf were longer on average (50 feet) than those in the eastern Gulf (38 feet). Longline vessels averaged about 42-44 feet in length and vessels using fish traps averaged about 38 feet. The average horsepower across all gear types was about 280 hp, the lowest with the longline vessels and the highest with vessels using fish traps. High volume longline vessels had the highest fuel capacity out of a range of 32-6,000 gallons. The average fuel capacity was 689 gallons.

Survey respondents reported having lived an average of 25 years in their current county or parish of residence; the overall average age of respondents was about 47 years with the mode at the 40-49 age group; 141 (72 percent) graduated from high school or had more than 12 years of formal education (Waters 1996). Household size ranged from 1-9 persons with an average of 3 persons. Household incomes ranged from less than $10,000 to more than $150,000 with approximately 50 percent of the respondents citing household incomes of $30,000 or less. Respondents averaged approximately 44 percent of household income from commercial fishing for reef fishes, 21 percent from other types of commercial fishing and 35 percent from all other sources including incomes earned in non-fishing jobs held by other household members, pensions, investments and other sources. The respondents had an average of 19 years experience at fishing, with 13.6 years of that experience in the positions they held at the time of the survey. Only 5 of the 196 respondents reported seasonal employment in other jobs. Typically, respondents from high volume vessels earned between 69-75 percent of household income from commercial fishing while respondents from low volume vessels earned 25-39 percent of household income from commercial fishing (except for bottom longlining vessels) (Waters 1996).

Waters (1996) also reported annual gross receipts per vessel in the reef fish fishery, as summarized by the following information:

High-volume vessels using vertical lines:	
Northern Gulf:	$110,070
Eastern Gulf:	$ 67,979
Low-volume vessels using vertical lines:	
Northern Gulf:	$ 24,095
Eastern Gulf:	$ 24,588
High-volume vessels using bottom longlines:	
Both areas:	$116,989
Low-volume vessels using bottom longlines:	
Both areas:	$ 87,635
High-volume vessels using fish traps:	$ 93,426
Low-volume vessels using fish traps:	$ 86,039

When combined with cost information, these figures translate into the following results for net income (defined as gross receipts less routine trip costs; the numbers in parenthesis represent the percent to gross receipts) (Waters 1996):

High-volume vessels using vertical lines:		
Northern Gulf:	$28,466	(26)

Eastern Gulf:	$23,822	(35)
Low-volume vessels using vertical lines:		
Northern Gulf:	$ 6,801	(28)
Eastern Gulf:	$ 4,479	(18)
High-volume vessels using bottom longlines:		
Both areas:	$25,452	(22)
Low-volume vessels using bottom longlines:		
Both areas:	$14,978	(17)
High-volume vessels using fish traps:	$19,409	(21)
Low-volume vessels using fish traps:	$21,025	(24)

5.3.1.2.3 Dealers and Processors

Approximately 227 dealers possess permits to buy and sell reef fish species (NOAA Fisheries Service 2004). Based on mail address data, most of these were located in Florida (146), with 29 in Louisiana, 18 in Texas, 14 in Alabama, 5 in Mississippi and 15 out of the Gulf States region. More than half of all reef fish dealers are involved in buying and selling grouper. These dealers may hold multiple types of permits.

Average employment information per reef fish dealer is not known. Although dealers and processors are not synonymous entities, Keithly and Martin (1997) reported total employment for reef fish processors in the Southeast at approximately 700 individuals, both part and full time. It is assumed that all processors must be dealers, yet a dealer need not be a processor. Further, processing is a much more labor-intensive exercise than dealing. The profit profile for dealers or processors is not known.

Based on the NOAA Fisheries Service annual processor survey, 29 firms were engaged in the processing of snapper and/or grouper in the Gulf of Mexico in 1996. Reported production of snapper and grouper by these 29 firms totaled 2.30 million pounds valued at $12.3 million. In 2005, the number of reported processors equaled 21 and output of processed grouper and snapper product totaled 1.5 million pounds. These numbers would indicate that only a small portion of the harvested reef fish product is processed (at least in the Gulf).

5.3.1.2.4 Imports

During the 15-year period ending in 2005, Gulf of Mexico commercial snapper landings (all species combined) ranged from 7.1 million pounds (1991) to 9.4 million pounds (1997) and averaged 8.6 million pounds annually. Imports of fresh snapper products during this period increased from 10.8 million pounds to 27.5 million pounds and averaged more than 20 million pounds annually. Imports of frozen snapper products ranged from about 1.5 million pounds to three million pounds prior to 2000 but have since increased to 12.7 million pounds in 2005. Hence, as indicated, domestic production is but a fraction of total imports of a similar product.

Since 1991, the dockside price of the domestic product has consistently exceeded the price of the imported fresh product by $0.25 to $0.50 per pound with no trend of an increasing or decreasing differential. On a deflated basis, the price differential has ranged from about $0.16 per pound to $0.37 per pound and with no distinguishable trend.

The observed price differential between the domestic and imported fresh snapper product can be the result of any number of factors. First, the mix of snapper species constituting the domestic product may vary from that of the imported product. Second, the seasonality of the domestic product compared to the imported product may account for some of the price differential. Third, the domestic product may simply be of higher quality. If the issue is one of quality, then one is led to conclude that the imported product does not represent a perfect substitute for the domestic product. However, if the price differential reflects seasonality or a different product mix, then one cannot rule out that the imported product is a perfect substitute for the domestic product.

Like fresh snapper, fresh grouper imports are also large, equaling 8.4 million pounds in 2005. Unlike fresh snapper, however, imports of fresh grouper have not risen steadily during the 15-year period ending in 2005. Rather, they trended upwards during the early-to-mid 1990's before reaching a maximum of about 13 million pounds in 1998. After declining in subsequent years, they once again increased to the noted 2005 level. Imports of frozen grouper are relatively minor, averaging less than one-million pounds annually in recent years.

As indicated in Table 5.3.1.2.1-2, Gulf of Mexico commercial grouper landings (shallow water and deep water, combined) have averaged about 10.6 million pounds annually during the nine-year period ending in 2003. This is about 15 percent above imports of the fresh product during the same period. While the price of the domestic grouper product exceeded the price of the comparable imported product by a sizeable amount in earlier years, the price differential has tended to narrow over time and there is currently little price differential between the two products.

5.3.1.3 Coastal Migratory Pelagics[19]

Managed species under the CMP FMP include king mackerel, Spanish mackerel, and cobia. The FMP treated king and Spanish mackerel as unit stocks in the Atlantic and Gulf of Mexico. The FMP established allocations for the recreational and commercial sectors harvesting these stocks, and the commercial allocations were divided between net and hook-and-line fishermen.

Since its implementation, the CMP FMP has been amended numerous times and there have been some changes (additions) to identified problems as well as objectives. Two of the more relevant objectives added (Amendment 5 and Amendment 6 to the CMP FMP) include (1) to minimize waste and bycatch in the fishery and (2) to optimize the social

19 Much of the discussion on coastal pelagics is taken directly from Amendment 15 to the CMP FMP and from the *EFH* Amendment.

and economic benefits of the coastal migratory pelagic fishery. The rationale for this last objective was to provide a goal to enhance economic benefits to all groups.

While detailed analyses of the amendments are beyond the scope of this document, there are a number of salient features addressed in these amendments that merit some attention. First, many of the amendments were enacted in response to allocation and/or gear issues. For example, Amendment 2 prohibited the use of purse seines on overfished stocks. Amendment 3, which was approved in 1990, prohibited drift gill nets for coastal pelagics and purse seines for the overfished groups of mackerels. Amendment 5 further refined gear usage by requiring that the Gulf group of king mackerel could only be taken by hook-and-line or with run-around gill nets. In addition, and of particular relevance to this amendment, actions taken in Amendment 5 limited cobia take to two per day per fisherman. As such, commercial harvests of cobia, as presented in a subsequent section, tend to be relatively minor.

Though direct control of effort was not seriously considered when the CMP FMP was first developed, more attention has been given to this issue over time. While the permit process was established under Amendment 1 to the CMP FMP, income requirements were relatively lax; proof that a minimum of ten percent of earned income was derived from commercial fishing activities. The somewhat unrestrictive criteria established under Amendment 1 would suggest that it had only a minor impact on restricting effort. The prohibition of purse seines on overfished stocks (Amendment 2) was an additional attempt to limit commercial effort though, as noted, the action was treated primarily as an allocation issue. Furthermore, the action only limited effort in one small segment of the commercial fishing sector. The first all-inclusive attempt to restrict effort in the commercial sector can be traced to Amendment 8. As noted in Amendment 8, available effort exceeded that needed to optimally harvest available TAC.

In response to the excessive and expanding level of effort, Amendment 8 established a moratorium on all commercial king mackerel permits until no later than October 15, 2000 with a qualification date for initial participation of October 16,1995. The purpose of this moratorium was to provide stability and prevent speculative entry into the fishery while the Councils developed a limited access or limited entry program. The amendment was also intended to reduce overfishing of the Gulf group king mackerel and aid in the recovery of the stock. More recently, Amendment 15 created a permanent limited access program in the fishery.

5.3.1.3.1 Permits and Landings

As noted, three species –king mackerel, Spanish mackerel, and cobia- are included in the *CMP FMP*. No permit is required to harvest cobia. In 1998, the first year of the king mackerel permit moratorium, there were 2,172 commercial permits[20]. That number has declined to 1,740 active permits in 2003. The number of vessels with federal permits for

20 Since the *CMP FMP* is a joint management plan between the Gulf and South Atlantic Fishery Management Councils, the number of permits referenced in this section refers to the total for the two areas.

commercial fishing for king mackerel declined at an average annual rate of 4.5 percent from 1998 through 2003.

Since 1995, Gulf of Mexico commercial landings of king mackerel have averaged 2.3 million pounds annually. The dockside value of this production has averaged $1.06 per pound. Examined on a deflated basis, the dockside price of king mackerel has gradually been declining over the past decade. In 1995, for example, the deflated price averaged $0.66 per pound. By 2005, it had fallen to $0.53 per pound (1982-84 Consumer Price Index).

Ex-vessel prices of king mackerel, the U.S. market, and estimated imports of king mackerel and possible substitute species have been described and analyzed using econometric models (Easley et al. 1993; Vondruska and Antozzi 1999; Vondruska 1999). The model results indicate that demand for king mackerel is relatively price elastic for the U.S. market as a whole. That is, compared with any given percentage change in market supply, the expected percentage change in ex-vessel price is much smaller, holding other factors constant.

Gulf of Mexico commercial landings of Spanish mackerel have averaged approximately one-million pounds per year since 1995 with an associated dockside value of approximately one-half million dollars. Overall, commercial landings of Spanish mackerel have fallen sharply since the mid-1990s due to, at least in part, the "Florida net ban" (as it is commonly referred to) that went into effect on July 1, 1995. Nets conducive to the harvesting of Spanish mackerel were prohibited at this point in time.

As noted, Amendment 5 to the CMP FMP limited the harvest of cobia to two per fishermen per day. Hence, Gulf of Mexico commercial harvests of this species are relatively minor. Average annual landings during 1995-2004 have averaged 175 thousand pounds annually. Since 2000, landings have averaged about 130 thousand pounds annually. Dockside value since 2000 has averaged approximately $260 thousand indicating an average price per pound of approximately $2.00.

5.3.1.3.2 Vessel Characteristics

As noted, the number of vessels that had active federal permits to fish commercially for king mackerel declined by 20 percent from 2,172 in 1998 to 1,740 in 2003 (data for July 15 of each year).[21] Only about half of these permitted vessels had logbook-reported nominal landings of king mackerel (at least one pound of harvest) in each respective year, varying from 1,066 vessels in 1998 to 951 vessels in 2003. The 951 vessels in 2003 harvested approximately 4.5 million pounds of king mackerel (from the Gulf and South Atlantic), valued at $6.19 million in gross revenues, and received $9.57 million in gross

21 Since the early 1990s, fishermen have completed and submitted FMP-mandated logbooks for commercial fishing trips for Gulf reef fish, Atlantic snapper-grouper, shark, and, since 1998, king and Spanish mackerel.

revenues from sales of all logbook reported landings on the trips that harvested king mackerel.

The median harvest per vessel for vessels with active permits and nominal landings of king mackerel ranged from 941 to 1,324 pounds of king mackerel per vessel per year during 1998 through 2003. It should be noted that these amounts are annual medians (50th percentiles) and not averages; e.g., in 1998, half of the 1,066 vessels landed between 1 pound and 941 pounds, while the other half landed more than 941 pounds. Medians are used for comparison rather than averages since vessel performance is not normally distributed. At the lower end of the annual frequency distributions of vessels respecting pounds landed, 25 percent of the vessels landed only 144 to 238 pounds or less per year (25th percentiles), or roughly 14 to 24 individual fish per year assuming an average of 10 pounds each per fish. The 25 percent of vessels at the upper end of the annual frequency distributions landed more than 3,791 to 5,219 pounds per year (75th percentiles). Hence, there is substantial difference in vessel performance and averages may not adequately represent fleet performance. The annual producer surplus for this fishery under the limited access program established under Amendment 15 to the *CMP FMP* was estimated to be $142,650 to $380,400 at the time that the program was being considered.

For all vessels, the median length was 31 feet; half of the vessels were 25 to 39 feet long. Overall, the median number of trips per year for king mackerel was 6 to 7 trips and 20 to 22 trips per year for all logbook-reported landings of fish. The median percentage of king mackerel revenues to all logbook-reported landings ranged from 22 percent to 33 percent of annual gross revenues, or $10,663 to $12,183.

There is very little information on fishermen, fishing-dependent businesses, or communities that depend on the king and Spanish mackerel fisheries. … mackerel fisheries are open only part of the calendar year, or mackerel are only available seasonally to some communities; therefore most fishermen participate in other fisheries as well, and the communities they live in or support are not specifically "mackerel communities". Areas where king mackerel play an important role in the community include Monroe County, Florida, Dare County, North Carolina, and Lafourche Parish, Louisiana.

5.3.1.3.3 Processing

There is apparently very little processing of king and Spanish mackerel conducted in the Gulf of Mexico. According to NOAA Fisheries Service processor survey data, less than three Gulf of Mexico based establishments have been engaged in king and/or Spanish mackerel processing activities since 1998.

5.3.1.3.4 Imports

The U.S. Department of Customs does not differentiate the various types of mackerel that are exported to the United States. Imports of fresh product from Latin American countries (i.e., those countries likely to be exporting similar mackerel products), however,

appear to be very limited (less than one-million pounds annually). Imports of frozen mackerel product from Latin American countries have fallen in the one million to four million pound range in recent years.

5.3.1.4 Spiny Lobster

Spiny lobsters are primarily harvested along the southern coast of Florida. Pounds landed in the Gulf, with few exceptions, generally fall in the 4.0 million to 6.5 million pound range.[22] Lobster pots represent the predominant gear used in the harvest of spiny lobster.

Imports dominate the U.S. supply (i.e., domestic production and imports) of spiny lobster. In 2004, for example, imports of spiny lobster (converted to a live-weight basis) equaled 95 million pounds, which equated to about 95 percent of the total supply. Since the mid-1990s, annual imports have fluctuated from about 75 million pounds to 95 million pounds with no clear trend. The domestic dockside price during this period has generally fallen in the $4.00 to $5.00 with no apparent trend and the dockside value of the Gulf harvested product has averaged approximately $20 million annually since 2000.

The commercial spiny lobster fishery has been dominated by the use of traps since the 1960s. Overall, the number of fishermen holding trap certificates fell from 3,766 in 1992/93 to 2,235 in 2001; or by about 40 percent (unpublished data provided by the Florida Fish and Wildlife Commission). The size of the average operation between 1993 and 1999, however, increased from approximately 196 to 252 certificates while the maximum number of certificates held by any individual increased from 3,674 to 5,631 (Milon *et al*., 1998).

5.3.1.5 Stone Crab

Harvests of wild stocks have varied since 1989-90. The largest landings (3.5 million pounds of claws) occurred in 1997-98. Landings in 2004-05 were about 3.0 million pounds. For the past decade (1995-96 to 2004-05 fishing seasons), the Gulf coast fishers have declawed approximately 10.5 million crabs during each seven-month fishing season.

The number of traps used to harvest stone crab has increased from an estimated 15,000 in the 1962-63 fishing season to 1.6 million traps in the 2001-02 season. The number of commercial trips also increased from 19,000 in the 1985-86 season to a maximum of 38,000 trips in the 1996-97. The number of traps fished has declined since 1996-97.

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22 The primary fishing area for spiny lobster, is as noted, the Florida Keys. Given the physical characteristic of this area, some discussion of the landings data is warranted. Specifically, all product landed in Monroe County, the primary landings port, is considered to be landed in the Gulf even though Monroe County traverses both the Gulf and South Atlantic Coasts. When examined by area caught, less than 3.0 million pounds of lobster are generally reported harvested from Gulf waters.

Stable landings after 1989-90 and the three-fold increase in the number of traps suggests that the current level of landings is all that can be harvested under current environmental conditions, regulations, and fishery practices

It takes 3-4 years before females reach legal claw size. Hence, offshore aquaculture of stone crab will likely entail a long period prior to seeing any positive return on investment.

5.3.1.6 Menhaden

The following discussion is largely summarized from Vaughan et al. (2007). Management of the Gulf menhaden fishery is through interstate agreement through the Gulf States Marine Fisheries Commission. Purse-seining of menhaden is prohibited off Florida and Alabama. The remaining Gulf States regulate harvest of Gulf menhaden in their territorial waters. Since the mid-1980s, both the number of reduction plants and the number of purse-seine vessels has significantly declined. Historically, as many as 14 reduction plants operated along the Gulf coast. As of 2004, only four reduction plants are in operation, and a single company owns three of the four plants. Similarly, the number of vessels peaked at around 80 vessels in the 1970s-1980s, and has declined since to 42 as of 2004. Most of the annual Gulf menhaden catch is from Louisiana (~92 percent). In more recent years, the percent of menhaden landings used for bait has increased, but still represents only a small fraction of the total overall landings. Most landings are processed and used for fish meal, oils, pet food, and fertilizer.

5.3.2 Recreational Fishing

Total expenditures for marine recreational fishing activities in the Gulf of Mexico during 2001 were estimated at more than $ 2 billion by one survey, while another survey estimated those expenditures during 1999 at more than $ 4 billion (U.S. FWS and U.S. Census Bureau 2001; Steinback *et al.* 2004). The highest expenditures on recreational fishing in 2001 occurred in West Florida, followed by Louisiana, Texas, Alabama, and Mississippi (U.S. FWS and U.S. Census Bureau 2001).

The recreational fishery of the Gulf of Mexico includes private individuals, rental boats, charter vessels, head boats and party boats. The private recreational sector in the Gulf of Mexico is surveyed through the Marine Recreational Fisheries Statistics Survey (MRFSS) except for the state of Texas. Outside research on the charter and head boat sector provides much of the descriptive data, whereas the MRFSS survey is generally used to describe the private angling sector.

In the Gulf states, about 3.3 million in-state anglers took almost 23 million trips and caught over 167 million fish in 2003. This tally of anglers and trips does not include anglers and trips taken solely in Texas for all fishing modes or solely through head boats for all Gulf states. More than 70 percent of anglers were from Florida, with the rest coming from Louisiana, Alabama and Mississippi, in that order. Florida accounted for a large percentage (70 percent) of the trips, followed in order by Louisiana, Alabama, and

Mississippi. The most commonly caught non-bait species were spotted seatrout, red drum, gray snapper, white grunt, sand seatrout, sheepshead, red snapper, king mackerel, and Spanish mackerel (NOAA Fisheries Service, 2004b).

The typical angler in the Gulf region is 44 years old, male (80 percent), white (90 percent), employed full time (92 percent), with a mean annual household income of $42,700. The mean number of years fished in the state was 16 years for GOM anglers. The average number of fishing trips taken in the 12 months preceding the interview was about 38 and these were mostly (75 percent) one-day trips where expenditures on average were less than $50. Seventy-five percent of surveyed anglers reported they held a saltwater license, and 59 percent of them owned boats used for recreational saltwater fishing. Those anglers who did not own their own boat spent an average of $269 per day on boat fees (Holiman, 1999) when fishing on a party/charter or rental boat. About 76 percent of these anglers who did not own their own boat were employed or self-employed and about 23 percent were unemployed, mostly due to retirement (Holiman, 2000). For-hire vessels are currently under a moratorium on the issuance of new for-hire federal permits to fish for reef fish or coastal migratory pelagics. A total of 3,340 permits were issued under the moratorium, and they are associated with 1,779 vessels. Of these vessels, 1,561 have both reef fish and coastal migratory pelagics permits, 64 have only reef fish permits, and 154 have only coastal migratory pelagics permits. About one-third of Florida charter boats targeted three or less species, two-thirds targeted five or less species and 90 percent targeted nine or less species. About 40 percent of these charter boats did not target particular species. The species targeted by the largest proportion of Florida charter boats were king mackerel (46 percent), grouper (29 percent), snapper (27 percent), dolphin (26 percent), and billfish (23 percent). In the eastern GOM, the species receiving the most effort were grouper, king mackerel and snapper. About one-fourth of Florida headboats targeted three or less species, three-fourths targeted four or less species and 80 percent targeted five or less species. About 60 percent of headboats did not target any particular species. The species targeted by the largest proportion of Florida headboats are snapper and other reef fish (35 percent), red grouper (29 percent), gag grouper (23 percent), and black grouper (16 percent). In the eastern GOM, the species receiving the most effort were snapper, gag and red grouper.

The majority of charter boats in Alabama, Mississippi, Louisiana, and Texas reported targeting snapper (91 percent), king mackerel (89 percent), cobia (76 percent), tuna (55 percent), and amberjack. The species receiving the largest percentage of effort by charter boats in the four-state area were snapper (49 percent), king mackerel (10 percent), red drum (6 percent), cobia (6 percent), tuna (5 percent), and speckled trout (5 percent). The majority of headboat/party boat operators reported targeting snapper (100 percent), king mackerel (85 percent), shark (65 percent), tuna (55 percent), and amberjack (50 percent). The species receiving the largest percentage of total effort by headboats/party boats in the four-state area were snapper (70 percent), king mackerel (12 percent), amberjack (5 percent), and shark (5 percent) (Sutton et al., 1999).

5.3.2.2 Private Anglers

There were over 20.4 million marine recreational fishing trips in the Gulf of Mexico during 2000 (excluding Texas) (GMFMC 2004). Most of those trips were made in Florida (72 percent) with Louisiana second (18 percent) and both Alabama and Mississippi with 5 percent. There were over 2.6 million participants who caught a total of 149 million fish. The species that were most commonly sought on fishing trips were red snapper, white grunt, dolphin, black sea bass, spotted sea trout, and red drum. Most often, the catch came on trips where individuals fished primarily in inland waters (64 percent) or in the state territorial sea (27 percent). Descriptions of private angler fishing appear in the appendices for the EFH FEIS under the description of each state's fishing communities (GMFMC 2004).

5.3.2.3 Charter, Head and Party boats

Charter boats are generally defined as for-hire vessels with a fee charged on a small group basis. Head boats and party boats also operate on a for-hire basis but with a per-person base fee charged. Charter boats are usually smaller, carrying six or fewer passengers. Party boats are larger and will carry as many passengers as possible to maximize income. They usually operate on a schedule and require a minimum number of passengers in order to make a trip. In their recent study of the Charter/Head boat sector for the Gulf States of Alabama, Mississippi, Louisiana, and Texas, Sutton *et al*. (1999) estimated there to be 430 charter vessel operators and 23 party boat operators in the four-state area. Over the past ten years there has been an increase in size and capacity of both charter and party vessels. Since 1987 charter vessels have more than doubled in number from 210-430 and the number of passenger-trips have tripled from 95,000 to 318,716. The state with the largest increase in number of passenger-trips was Mississippi with a 300 percent increase. Alabama was next with an increase of 165 percent, since 1987. Party boats have decreased in number since 1987 from 26 to 23. However, the number of passenger-trips, as with charter vessels, has tripled from 37,148 to 117,990. This increase may be attributed to the increase in size of vessels. Sutton *et al*. (1999) estimated the impact of the charter industry on local economies for the four states in their study in 1997 to be $42.5 million in direct output, $15.6 million in income and 996 jobs.

The charter industry has raised concerns over certain aspects of the above study, specifically certain costs for repair and targeting behavior. The Gulf Socioeconomic Panel has also provided the GMFMC with a critique of the methodology and assumptions made in the report. However, the purpose here is to describe prior research for comparison and discussion purposes only. Holland *et al*. (1999) estimated there to be 615 charter and head boats on Florida's Gulf coast and approximately 230 in the Florida Keys. Major ports in Florida on the Peninsula Gulf - Naples and Ft. Myers (and Ft. Myers Beach); on Florida's Panhandle Gulf - Destin, Panama City (and Panama City Beach) and Pensacola; and in the Florida Keys - Key West, Marathon and Islamorada. In their sample, most charter boat operators in Florida (90 percent) operate full-time charter businesses and have been in business for an average of 16 years. The majority (95 percent) lives near their homeport and has lived in their home county for more than 10 years. Head boat operators also were full time had been in business on average 22 years.

Like their charter boat counterparts they too lived near their homeport and almost all had lived in their county for more than ten years.

5.3.3 Fishing Communities

A "fishing-dependent community" is defined in the MSFCMA, as amended in 1996, as "a community which is substantially dependent on or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community" (MSFCMA section 3(16)). In addition, the National Standard Guidelines define a fishing-dependent community as a social or economic group whose members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing or on directly related fisheries-dependent service and industries (for example, boatyards, ice suppliers, tackle shops)(50 CFR §600.345(b)(3).

The literature on fishing-dependent communities addresses three areas: identification of the communities, selection of variables appropriate for assessment and the assessment method itself. Community identification and selection criteria can be very complex or very simple. A simple first level approach would involve examining social and demographic variables at the county level where some fishing activity occurs. A more complex approach involves attempting to gather data and information on as small an entity as possible that qualifies as a fishing community. As the definition of community moves farther from traditional economic or political entities, less official data are available and more field research is required to complete the baseline profile and include relevant social and cultural value data.

Jacob et al. (2001) developed a protocol for defining and identifying fishing-dependent communities in accordance with National Standard 8. The project used central place theory to identify communities. A central place is where services, goods and other needs are met for the residents in the central place, as well as for those in surrounding hinterlands. It differs from using an administrative unit such as county boundaries, which may distort smaller communities or locality data as it is aggregated. The authors believed central place theory works well for defining and identifying fishing-dependent communities or localities as it provides a geographic basis for including multiplier effects that capture forward and backward linkages. In most fishing-dependent communities, forward linkages include those businesses that handle the fish once it is brought to the dock, such as fish houses, wholesalers, exporters, and seafood shops and restaurants. Backward linkages are the goods and services fishermen depend upon such as boat building and repair; net making and repair; marinas; fuel docks; bait, tackle and other gear vendors. Using their protocol of defining fishing-dependent communities, the authors initially determined five communities as commercially fishing-dependent and seven communities as recreationally fishing dependent. Further investigations resulted in validating five communities as commercially fishing dependent. The authors expressed little confidence in the data used and indicators developed based on such data to confirm the other communities as recreationally fishing-dependent communities. The five

commercially fishing-dependent communities in Florida are: Steinhatchee, Apalachicola, Panama City, Ochopee/Everglades City, and Panacea.

The Generic Essential Fish Habitat Amendment (GMFMC 2004) provides more extensive characterization of fishing-dependent communities throughout the Gulf coasts. The fishing communities included in the characterizations are: (1) Alabama: Fairhope, Gulf Shores, Orange Beach, Bayou La Batre, and Dauphin Island; (2) Florida: Pensacola, Gulf Breeze, Ft. Walton Beach, Destin, Panama City, Panama City Beach, Port St. Joseph, Apalachicola, East Point, Carabelle, St. Marks, Horseshoe Beach, Cedar Key, Yankeetown, Inglis, Crystal River, Homosassa, New Port Richey, Tarpon Springs, Clearwater, Madeira Beach, St. Petersburg, Tampa, Cortez, Matlacha, Bokeelia, Ft. Myers Beach, Naples, Marco Island, Everglades City, Key Largo, Islamorada, Marathon, Big Pine Key-Summerland Key, and Key West; (3) Louisiana: Venice, Empire, Grand Isle, Golden Meadow, Cutoff, Chauvin, Dulac, Houma, Delcambre, Morgan City, and Cameron; (4) Mississippi: Pascagoula, Gautier, Biloxi, and Gulfport; and, (5) Texas: Port Arthur, Galveston, Freeport, Palacios, Port Lavaca, Seadrift, Rockport, Port Aransas, Aransas Pass, Brownsville, Port Isabel, and South Padre Island.

Holland et al. (1999) identified the following areas as major activity centers for charter boats in Florida: Miami, Fort Lauderdale, Key West, Marathon, Islamorada, Naples, Ft. Myers, Ft. Myers Beach, Panama City, Panama City Beach, Destin and Pensacola. They also identified the following as major activity centers for headboats in Florida: Miami, Key West, Marathon, Islamorada, Ft. Myers, Ft. Myers Beach, Clearwater, Destin, Panama City and Panama City Beach. Sutton et al. (1999) identified the following areas as major activity centers for charter boats in the rest of the Gulf: South Padre Island, Port Aransas, and Galveston-Freeport in Texas; Grand Isle-Empire-Venice in Louisiana; Gulfport-Biloxi in Mississippi; and, Orange Beach-Gulf Shores in Alabama. They also identified the following areas as major activity centers for headboats in the rest of the Gulf: South Padre Island, Port Aransas, and Galveston-Freeport in Texas and Orange Beach-Gulf Shores in Alabama.

The communities that will be affected as a result of developing offshore aquaculture in the Gulf are difficult to project at this time. There is no information available that describes where firms will have their headquarters, where their supplies will be purchased, where employees will be hired or live, where the offshore facilities will be located, or how social conditions will change. Until the firms develop their infrastructure, discussions of the communities that will be impacted are based upon conjecture.

To provide discussion in this document, five communities have been selected that represent different attributes that may interrelate with the aquaculture industry. Additional information regarding demographics of the communities can be obtained from reports developed by Impact Assessment, Inc. These reports are available on the NOAA Southeast Region web site at http://sero.nmfs.noaa.gov/publications/publications.htm.

The first community selected was Galveston, Texas. Galveston was selected for two reasons, (1) because it is important to the red snapper fishery and (2) it is close to the major metropolitan area of Houston. Red snapper is discussed in this amendment one of the primary candidates for offshore aquaculture production in the Gulf. Houston, being a major city, would provide a substantial market for fresh production. If a quality product is produced, Houston restaurants and fish sellers have the potential to create a strong demand for the local production.

Port Fourchon, Louisiana is the second community that will be discussed. Port Fourchon was selected because it is the main staging area for offshore oil and gas production in the Gulf. If the offshore aquaculture industry utilizes oil and gas structures, Port Fourchon may be a logical location to base the shore support industry.

Bayou La Batre, Alabama was selected because it is one of the primary remaining commercial harvesting towns for shrimp. While this amendment would prohibit shrimp from being cultured offshore, Bayou La Batre possesses the infrastructure to support offshore aquaculture.

Panama City, Florida was selected as the fourth community. It is moderately sized community that has a diverse economic base comprised of local military base, tourism, commercial fishing, and recreational fishing. Panama City also is home to some fish processing facilities. Future research could consider the interactions between processors of wild stocks and species raised using aquaculture.

The final community discussed is Madiera Beach, Florida. Maderia Beach is an important location for the Gulf grouper fishery. It is also the location from where one offshore aquaculture application has been submitted.

Each of these communities will be discussed in terms of their social and economic characteristics. The reports used to provide this information were developed for NOAA Fisheries Service to identify fishing communities associated with the fishing industry by Impact Assessment, Inc (2005). All of the information for the various communities is taken directly from those reports. Summary statistics and demographics for each community are provided in Tables 5.3.3-1 to 5.3.3-14.

Galveston, Texas is an incorporated community with a population of 57,247 reported in the 2000 census. *"Galveston is a 32-mile-long, two-mile-wide barrier island located directly west of the Gulf of Mexico and east of mainland Galveston County. Houston is approximately 50 miles north. The University of Texas Medical Branch is the leading employer (Galveston, Texas Chamber of Commerce). Tourism, commercial and recreational fishing, and various maritime industry at the Port of Galveston are also highly significant in economic terms.*

Galveston Island was once home to Karankawa tribes, who hunted and fished in the area's resource-rich bays and sounds. The first non-indigenous settlement was

established in 1817 by pirate Jean Laffite (Texas Online 1998). Galveston was incorporated in 1839 (McComb 2002).

Galveston's economy initially revolved around its port, with cotton as the principal export product. The area grew steadily until an outbreak of yellow fever killed approximately 75 percent of Galveston's population between 1867 and 1873. Another major setback occurred in 1900 when the Galveston hurricane flooded the island and 6,000 people died (McComb 2002). The population steadily increased over the course of the 20th century in large part in associated with immense growth around Houston.

The year 2000 census enumerated 57,247 residents, a three percent decline from 1990. During that ten year period, employment in several major industries such as agriculture, forestry, fishing and hunting, mining, and manufacturing underwent some measure of decline. Jobs in the both the management and government sectors accounted for over 67 percent of jobs held by residents during the period. Many residents now work in tourism related services, such as those provided by the numerous dockside inns and hotels that serve visitors along the Galveston waterfront.

Both commercial and recreational fishing services and infrastructure are available in the area. For instance, eight public boat ramps provide convenient access to the Gulf and back bays, and several docks and marinas, ocean sightseeing tours, and charter fishing services provide 109 amenities for visitors. A highly productive shrimp and bottom fish fleet is also based here, with numerous commercial fishing vessels mooring along the waterfront. A number of seafood dealers and retailers, and boat builder and brokers are located in Galveston as well. As of 2003, three Galveston residents held Gulf shrimp permits." (Impact Assessment, Inc., 2005)

The total combined commercial landings of all species in Galveston during 2002 were 5,491,872 pounds and had an ex-vessel value of $13,476,895. There were a total of 75 commercial fishing license holders (56 State and 19 Federal) in 2000. A total of 2,551 persons held State Saltwater Licenses to fish recreationally.

Table 5.3.3-1. Galveston Demographics

Factor	1990	2000
Total population	59,070	57,247
Gender Ratio M/F (Number)	28,539/30,531	27,649/29,598
Age (Percent of total population)		
Under 18 years of age	24.7	23.4
18 to 64 years of age	61.9	62.9
65 years and over	13.4	13.7
Ethnicity or Race (Number)		
White	36,315	33,582
Black or African American	17,161	14,592
American Indian and Alaskan Native	144	243
Asian	1,387	1,839
Native Hawaiian and other Pacific Islander	N/A	42
Some other race	4,063	5,571
Two or more races	N/A	1,378
Hispanic or Latino (any race)	12,649	14,753
Educational Attainment (Population 25 and over)		
Percent with less than 9th grade	13.7	10.3
Percent high school graduate or higher	70.0	74.4
Percent with a Bachelor's degree or higher	21.1	23.7
Language Spoken at Home (Population 5 years and over)		
Percent who speak a language other than English at home	19.8	26.5
And Percent who speak English less than very well	7.6	11.2
Household income (Median $)	20,825	28,895
Poverty Status (Percent of population with income below poverty line)	24.2	22.3
Percent female headed household	16.3	16.9
Home Ownership (Number)		
Owner occupied	10,136	10,399
Renter occupied	14,021	13,443
Value Owner-occupied Housing (Median $)	57,200	73,800
Monthly Contract Rent (Median $)	309	531
Employment Status (Population 16 yrs and over)		
Percent in the labor force	62.7	59.7
Percent of civilian labor force unemployed	9.0	10.1
Occupation** (Percent in workforce)		
Management, professional, and related occupations	N/A	35.2
Service occupations	N/A	24.2
Sales and office occupations	N/A	24.0
Farming, fishing, and forestry occupations	1.8	0.3
Construction, extraction, and maintenance occupations	N/A	8.3
Production, transportation, and material moving occupations	N/A	8.0
Industry** (Percent in workforce)		
Agriculture, forestry, fishing and hunting	1.5	0.3

Mining (includes the offshore oil/gas industry workforce)	1.0	0.5
Manufacturing	5.7	4.1
Percent government workers	32.1	31.5
Commuting to Work (Workers 16 yrs and over)		
Mean travel time to work (minutes)	N/A	19.1
Percent worked outside of county of residence	5.5	9.5

**Differences in the types of data the U.S. Census Bureau used to generate Occupation and Industry percentages in 1990 and 2000 preclude valid comparisons between those census years.

Table 5.3.3-2. Fishing Infrastructure and Services Observed in Galveston in 2003

Infrastructure or Service	**Quantity**
Air fill stations (diving)	1
Boat yards/ Boat builders (recreational/commercial)	1
Churches with maritime theme	1
Docking facilities (commercial)	8
Fishing Gear, Electronics, Welding, and other repair	5
Fishing associations (recreational/commercial)	2
Fish processors, Wholesale fish house	3
Fisheries research laboratories	1
Fishing monuments	0
Fishing pier	20
Hotels/Inns (dockside)	~20
Marine railways/haul out facilities	0
Museums—fishing/marine-related	0
Net makers	1
NOAA Fisheries Service or state fisheries office (port agent, etc.)	1
Public boat ramps	8
Recreational docks/marinas	5
Bait & Tackle/fishing supplies	20
Recreational Fishing Tournaments	Numerous
Sea Grant Extension office	1
Seafood restaurants	~20
Seafood retail markets	8
Trucking operations	0
Site-seeing/pleasure tours	10
Charter/Head Boats	12
Commercial Boats	25

Source: Impact Assessment, Inc. 2005.

Table 5.3.3-3. Primary Fishing-related Businesses Listed for Galveston in 2003

Type of Business	**Frequency**
Boat Builder/Broker	10
Boat Builder/Broker; Marina	1
Boat Rentals & Pier	9
Boat Rentals & Pier; Retail Seafood Dealer	1
Marina	13
Processor; Retail Seafood Dealer	1
Retail Seafood Dealer	6
Retail/Wholesale Seafood Dealer	3
Wholesale Seafood Dealer	2
Total	*46*

Source: Impact Assessment, Inc. 2005.

Port Fourchon, Louisiana's population is over-estimated in the 2000 U.S. Census (1,266). *"The community is located in the far southern portion of Lafourche Parish where Bayou Lafourche meets the Gulf of Mexico. Port Fourchon is an industrial center for deepwater petroleum exploration and development in the Gulf. It is also very likely the largest single concentration of offshore petroleum support facilities in the lower-48. The Louisiana Offshore Oil Port (LOOP), the nation's only super port, is located 19 miles southeast. Constructed by a group of major oil and pipeline companies, LOOP is the central point of distribution for supertankers in the Gulf region.*

While extensive offshore petroleum support facilities and vessel operations dominate the landscape and local economy, Port Fourchon is also a harbor for several deep sea charter boats and offshore shrimp trawlers. The offshore trawlers are docked at two locations near the southern and northern ends of the port near a small marina. As is the case for Leeville, secondary source data for Port Fourchon are sparse at best. This is due in large part because there is no permanent residential area here. Vessels are kept here, and captains operate from the area but live elsewhere.

There are many fish camps fronting Bayou Terellon along Route 3090 near Port Fourchon; these are almost entirely recreational/weekend dwellings. A great deal of fishing occurs in the adjacent bayous and canals. There are also a growing number of upscale camp settlements west of the junction of Highway 1 and Route 3090. Various offshore sports fishing vessels are docked along the canal here.

*Year 2000 census figures do not accurately portray the resident population of Port Fourchon in that census-delineated tracts for this area include part of the populations of Grand Isle and Leeville. In reality, there are few permanent residents here; many persons who moor their vessels here live north of the port in communities along Bayou Lafourche, or as far away as Houma", (*Impact Assessment, Inc., 2005).

There was no fishing-related businesses listed for Port Fourchon in 2003, nor was there any information on commercial landings or value in 2000. No commercial fishing

licenses were reported as being held by persons with a physical address in Port Fourchon in 2000. A total of 483 recreational State saltwater fishing licenses were sold in the community during 2000.

Table 5.3.3-4. Port Fourchon Demographics

Factor	1990	2000
Total population	1,372	1,266
Gender Ratio M/F (Number)	653/608	640/626
Age (Percent of total population)		
Under 18 years of age	28.2	23.1
18 to 64 years of age	63.8	61.4
65 years and over	8.0	15.5
Ethnicity or Race (Number)		
White	1,175	1,124
Black or African American	1	7
American Indian and Alaskan Native	68	106
Asian	14	0
Native Hawaiian and other Pacific Islander	N/A	0
Some other race	3	5
Two or more races	N/A	24
Hispanic or Latino (any race)	8	9
Educational Attainment (Population 25 and over)		
Percent with less than 9th grade	49.0	18.5
Percent high school graduate or higher	34.6	47.6
Percent with a Bachelor's degree or higher	1.4	3.2
Language Spoken at Home (Population 5 years and over)		
Percent who speak a language other than English at home	44.8	38.7
And Percent who speak English less than very well	13.5	7.5
Household income (Median $)	18,935	19,062
Poverty Status (Percent of population with income below poverty line)	32.3	21.4
Percent female headed household	7.4	6.8
Home Ownership (Number)		
Owner occupied	333	408
Renter occupied	76	58
Value Owner-occupied Housing (Median $)	33,100	48,950
Monthly Contract Rent (Median $)	222	334
Employment Status (Population 16 yrs and over)		
Percent in the labor force	51.5	47.8
Percent of civilian labor force unemployed	2.1	4.2
Occupation** (Percent in workforce)		
Management, professional, and related occupations	N/A	12.0
Service occupations	N/A	15.8
Sales and office occupations	N/A	31.6

Farming, fishing, and forestry occupations	7.8	4.9
Construction, extraction, and maintenance occupations	N/A	10.6
Production, transportation, and material moving occupations	N/A	24.9
Industry** (Percent in workforce)		
Agriculture, forestry, fishing and hunting	6.4	6.2
Mining (includes the offshore oil/gas industry workforce)	7.7	8.9
Manufacturing	3.6	5.1
Percent government workers	12.7	2.2
Commuting to Work (Workers 16 yrs and over)		
Mean travel time to work (minutes)	40.0	18.8
Percent worked outside of county of residence	15.4	14.1

**Differences in the types of data the U.S. Census Bureau used to generate Occupation and Industry percentages in 1990 and 2000 preclude
valid comparisons for those census years.

Table 5.3.3-5. Fishing Infrastructure and Services Observed in Port Fourchon in 2003

Factor	**Quantity**
Commercial Vessels	-
Trawls	30-40
Skimmers	0
Butterfly	0
Crabbers	0
Oyster	0
Other Commercial	3-5 Charter boats, 50-60 oil field support vessels
Recreational Vessels	-
Freshwater	0
Saltwater	0
Infrastructure and Services -	-
Marinas	1
Seafood Docks/Dealers	1
Commercial Ship/Boat Repair	0
Commercial Ship/Boat Builders	0
Net Makers/Dealers	0
Commercial Marine Supply	2
Seafood Transport	2
Air Fill Stations (diving)	0
Fishing Pier	0

Source: Impact Assessment, Inc. 2005.

Bayou La Batre, Alabama is an incorporated community with a population of 2,313 reported in the 2000 U.S. Census. *"Bayou La Batre is located along State Highway 188*

in southern Mobile County. It is adjacent to the body of water of the same name. The bayou empties into Mississippi Sound, providing easy access to several major ship channels and the Gulf of Mexico. Bayou La Batre is some 25 miles south of Mobile and approximately 22 miles east of the Pascagoula-Moss Point, Mississippi Metro area. The Gulf of Mexico is about 17 miles south, accessible via Portersville Bay and the Mississippi Sound.

Bayou La Batre was founded in the 1780's by a Frenchman named Joseph Bosarge. "La Batre" refers to a strategic battery built by the French during that period. Following the introduction of rail service in the late 1800s, the area developed as a resort town (Howell 2003). A hurricane so devastated the area in 1906 that commercial fishing became the only source of income. Residents subsequently established a lengthy history of involvement in the harvest, processing, and distribution of seafood.

The year 2000 census enumerated 2,313 persons in Bayou La Batre, a decline from the 1990 count of 2,456. Most residents were employed in manufacturing industries or sales occupations in 2000. The commercial fishing and processing industries are vital to the local economy. Shrimp, oysters, crabs, and finfish are primary products. The commercial fishing industry here reportedly generates direct and indirect revenue of nearly $80 million per year, with an approximate annual ex-vessel value of nearly $30 million. According to the Auburn University Marine Extension and Research Center (2001), Bayou La Batre was ranked 10th in value of landings for all U.S. ports in 2000. Fishery participants from Bayou La Batre also produce the majority of Alabama seafood landings; shrimp accounts for 90 percent of landed seafood value. Crews for hundreds of shrimp vessels work out of and deliver product to Bayou La Batre. Local processing activities include cleaning, heading, picking, shucking, grading, breading, packaging, frozen storage, and transportation. Much of the seafood processed in Bayou La Batre's processing plants is trucked in from out-of-state. These plants employ approximately 1,500 year-round workers and 800 seasonal workers. An additional number of packing houses and wholesale seafood dealers employ many year-round and seasonal workers. There are also at least a dozen marine supply shops and marine electronics firms in Bayou La Batre (Bayou La Batre Chamber of Commerce). Shipbuilding is Bayou La Batre's other major industry. Oil supply boats, work boats, barges, shrimp boats, tugs, cruisers, and casino boats are among the vessels built in Bayou La Batre(Bayou La Batre Chamber of Commerce).

There is a small downtown business district at the intersection of Shell Belt Road and State Road 188. Shell Belt Road is the address of many fishing-related industries, such as seafood processors, fish houses, and boat building yards. Numerous shrimp vessels are docked nearby. There are no bars, hotels, or non-fishing related businesses located on the bayou. A NOAA Fisheries Service port agent has an office in town. A population of persons of Vietnamese ancestry is involved in all facets of the local seafood industry. Many settled in the community with the help of the Catholic Church after the end of the Vietnam War. The local fishing fleet here ranges from small bay boats that fish for shrimp and finfish to large Gulf vessels (called "steel slabs") that make extended trips throughout the Gulf of Mexico and Southeast Atlantic. There are small seafood dealers

that handle shrimp, crab, oysters, and finfish and large-scale processors that ship specialty products worldwide. All types of support businesses from net manufacturers to marine electronics dealers are located here. A blessing of the fleet" and a "Miss Seafood Contest" are held here each year. According to one fishery specialist, the recent rise in fuel prices and the increase in imports and subsequent drop in price for domestic shrimp have forced Alabama shrimp fishermen to adjust their annual fishing pattern. In the past, fishing trips would be made during the off-season even though shrimp were not as abundant since the trips were still economically feasible. That is no longer the case, and many vessels remain tied to the dock during the off-season - returns can no longer cover operating costs.

In 2000, 24 processors were located in Bayou La Batre, average of 30 employees were employed by each that year. Some 36 million pounds of seafood valued at over $123 million were produced that year. A large federally-permitted shrimp fleet is based in Bayou La Batre, and many vessels from around the region are moored here," (Impact Assessment, Inc., 2005).

Commercial landings reported for Bay La Batre during 2003 were 4,615,977 lbs and were valued at $7,744,316 ex-vessel. A total of 45 commercial fishing permits were held by persons with an address in the community (35 State permits and 10 Federal Permits).

Table 5.3.3-6. Bayou La Batre Demographics

Factor	1990	2000
Total population	2,456	2,313
Gender Ratio M/F (Number)	1,201/1,255	1,159/1,154
Age (Percent of total population)		
Under 18 years of age	34.3	29.9
18 to 64 years of age	54.7	59.0
65 years and over	11.0	11.2
Ethnicity or Race (Number)		
White	1,605	1,213
Black or African American	250	237
American Indian and Alaskan Native	3	6
Asian	595	770
Native Hawaiian and other Pacific Islander	N/A	10
Some other race	3	22
Two or more races	N/A	55
Hispanic or Latino (any race)	67	44
Educational Attainment (Population 25 and over)		
Percent with less than 9th grade	30.0	24.0
Percent high school graduate or higher	45.2	54.9
Percent with a Bachelor's degree or higher	6.0	7.4
Language Spoken at Home (Population 5 years and over)		
Percent who speak a language other than English at home	26.3	29.1
Percent who speak English less than very well	18.0	15.8
Household income (Median $)	15,775	24,539

Poverty Status (Percent of population with income below poverty line)	36.1	28.2
Percent female headed household	15.6	17.6
Home Ownership (Number)		
Owner occupied	537	501
Renter occupied	234	268
Value Owner-occupied Housing (Median $)	35,200	45,800
Monthly Contract Rent (Median $)	164	366
Employment Status (Population 16 yrs and over)		
Percent in the labor force	54.2	53.7
Percent of civilian labor force unemployed	9.7	11.1
Occupation** (Percent in workforce)		
Management, professional, and related occupations	N/A	14.1
Service occupations	N/A	18.3
Sales and office occupations	N/A	20.7
Farming, fishing, and forestry occupations	8.6	5.2
Construction, extraction, and maintenance occupations	N/A	10.8
Production, transportation, and material moving occupations	N/A	30.9
Industry** (Percent in workforce)		
Agriculture, forestry, fishing and hunting, (and mining)	11.6	8.4†
Manufacturing	23.4	21.9
Percent government workers	9.0	7.7
Commuting to Work (Workers 16 yrs and over)		
Mean travel time to work (minutes)	N/A	23.9
Percent worked outside of county of residence	12.2	9.5

Source: Impact Assessment, Inc. 2005.
**Differences in the types of data used to generate Occupation and Industry percentages in 1990 and 2000 preclude valid comparisons between those census years. † Year 2000 figures include mining in this group; 1990 figures do not. Mining includes the offshore oil industry workforce.

Table 5.3.3-7. Fishing Infrastructure and Services Observed in Bayou LaBatre in 2003

Infrastructure or Service	Quantity
Air fill stations (diving)	0
Boat yards/ Boat builders (recreational/commercial)	0
Churches with maritime theme	2
Docking facilities (commercial)	Several
Fishing Gear, Electronics, Welding, and other repair	0
Fishing associations (recreational/commercial)	0
Fish processors, Wholesale Fish House	50
Fisheries research laboratories	0
Fishing monuments/ festivals	1

Fishing pier	1
Hotels/Inns (dockside)	0
Marine railways/haul out facilities	Several
Museums—fishing/marine-related	0
Net makers	2
NOAA Fisheries Service or state fisheries office (port agent, etc.)	2
Public boat ramps	1
Recreational docks/marinas	0
Bait & Tackle/fishing supplies	0
Recreational Fishing Tournaments	0
Sea Grant Extension office	0
Seafood restaurants	2
Seafood retail markets	0
Trucking operations	3
Site-seeing/pleasure tours	0
Charter/Head Boats	3
Commercial Boats	~300

Source: Impact Assessment, Inc. 2005.

Table 5.3.3-8. Primary Fishing-related Businesses Listed for Bayou La Batre in 2003

Type of Business	**Frequency**
Boat Builder/Broker	12
Boat Builder/Broker; Marina	3
Boat Rentals & Pier	1
Fish Hatchery	1
Marina	1
Processor	5
Processor; Retail/Wholesale Seafood Dealer	4
Processor; Wholesale Seafood Dealer	2
Retail/Wholesale Seafood Dealer	1
Wholesale Seafood Dealer	9

Source: Impact Assessment, Inc. 2005.

Panama City, Florida is an incorporated community with a population of 36,417 reported in the 2000 U.S. Census. *"Panama City is located on St. Andrews Bay just inland from the Gulf in the central panhandle region. The city is typically accessed by U.S. Highway 98 and State Highway 22. Tallahassee is nearly 100 miles to the southwest. Local and visiting fishing vessels access the Gulf through the channel at St. Andrew Bay, roughly two miles from the waterfront.*

The town was named in 1906 under the leadership of developer G.M. West, and incorporated in 1909. Development focused on the waterfront, where numerous piers, a post office, and the city jail were built. In 1908, the Atlanta and St. Andrew Bay Railroad

connected Panama City with cities to the north. In 1913, Panama City became the seat of Bay County.

The year 2000 census enumerated 36, 417 persons in Panama City, up from 34,378 in 1990. More than 6,700 residents are employed at neighboring Tyndal Air Force Base. The U.S. Navy maintains a 648-acre Coastal Systems Station in the area, and employs approximately 2,200 persons, many of whom reside in Panama City. Many residents are employed in positions associated with regional commerce and government. There are numerous commercial and recreational fishing businesses in Panama City. At least 100 commercial and charter vessels moor at various harbors. Several wholesale fish houses handle a wide variety of finfish and shellfish, and there are numerous bait and tackle shops, ship stores, boat builders and dealers, fishing piers, and marinas where charter fishing is offered. There were nine active processors in 2000, employing a total of 55 persons on average that year. In short, there is considerable infrastructure for both commercial and recreational fishing," (Impact Assessment, Inc., 2005).

Commercial landings reported for Panama City during 2002 were 1,972,052 lbs and were valued at $3,869,807 ex-vessel. A total of 264 commercial fishing permits were held by persons with an address in the community (125 State permits and 139 Federal Permits). A total of 1,352 State saltwater licenses were held by persons that reported Panama City as their address on the license.

Table 5.3.3-9. Panama City Demographics

Factor	1990	2000
Total population	34,378	36,417
Gender Ratio M/F (Number)	16,094/18,284	17,683/18,734
Age (Percent of total population)		
Under 18 years of age	24.5	23.0
18 to 64 years of age	58.5	61.1
65 years and over	17.0	15.9
Ethnicity or Race (Number)		
White	25,954	26,819
Black or African American	7,500	7,813
American Indian and Alaskan Native	215	231
Asian	583	564
Native Hawaiian and other Pacific Islander -- 28 Some other race	126	274
Two or more races	–	688
Hispanic or Latino (any race)	460	1,060
Educational Attainment (Population 25 and over)		
Percent with less than 9th grade	12.1	6.7
Percent high school graduate or higher	70.3	79.2
Percent with a Bachelor's degree or higher	16.7	18.9
Language Spoken at Home (Population 5 years and over)		
Percent who speak a language other than English at home	5.3	7.2
Percent who speak English less than very well	1.9	2.0

Household income (Median $)	26,629	31,572
Poverty Status (Percent of population with income below poverty line)	19.6	17.2
Percent female headed household	23.0	15.4
Home Ownership (Number)		
Owner occupied	8,193	8,565
Renter occupied	5,860	6,254
Value Owner-occupied Housing (Median $)	49,800	75,800
Monthly Contract Rent (Median $)	279	526
Employment Status (Population 16 yrs and over)		
Percent in the labor force	58.6	56.4
Percent of civilian labor force unemployed	8.0	5.8
Occupation** (Percent in workforce)		
Management, professional, and related occupations	--	32.2
Service occupations	--	20.8
Sales and office occupations	--	27.7
Farming, fishing, and forestry occupations	1.5	0.4
Construction, extraction, and maintenance occupations	--	8.6
Production, transportation, and material moving occupations	--	10.4
Industry** (Percent in workforce)		
Agriculture, forestry, fishing and hunting	1.5	0.5†
Manufacturing	7.7	7.0
Percent government workers	20.4	18.6
Commuting to Work (Workers 16 yrs and over)		
Percent in carpools	12.5	13.7
Percent using public transportation	0.2	0.7
Mean travel time to work (minutes)	--	18.6
Percent worked outside of county of residence	1.8	3.3

Source: Impact Assessment, Inc. 2005.
**Differences in the types of data the U.S. Census Bureau used to generate Occupation and Industry percentages in 1990 and 2000 preclude valid comparisons between those census years. †Year 2000 figures include mining in this group; 1990 figures do not. Mining includes the offshore oil industry workforce.

Table 5.3.3-10. Fishing Infrastructure and Services Observed in Panama City in 2003

Infrastructure or Service	**Quantity**
Air fill stations (diving)	Several
Bars/clubs (dockside or in town)	Several
Boat yards/ Boat builders (recreational/commercial)	Several
Churches with maritime theme	None observed
Docking facilities (commercial)	0
Fishing Gear, Electronics, Welding, and other repair	0
Fishing associations (recreational/commercial)	0
Fish processors, Wholesale Fish House	6

Fisheries research laboratories	0
Fishing monuments	0
Fishing pier	0
Hotels/Inns (dockside)	0
Marine railways/haul out facilities	0
Museums—fishing/marine-related	0
Net makers	0
NOAA Fisheries Service or state fisheries office (port agent, etc.)	0
Public boat ramps	8
Recreational docks/marinas	15+
Bait & Tackle/fishing supplies	15+
Recreational Fishing Tournaments	Several
Sea Grant Extension office	0
Seafood restaurants	10+
Seafood retail markets	20+
Trucking operations	0
Site-seeing/pleasure tours	0
Charter/Head Boats	100+
Commercial Boats	100+

Source: Impact Assessment, Inc. 2005.

Table 5.3.3-11. Primary Fishing-related Businesses Listed for Panama City in 2003

Type of Business	**Frequency**
Boat Builder/Broker	44
Boat Builder/Broker Boat Rentals & Pier	1
Boat Builder/Broker Diving & Fishing Equipment	1
Boat Builder/Broker Marina	13
Boat Rentals & Pier	15
Boat Rentals & Pier Marina	1
Marina	17
Retail Seafood Dealer	19
Retail/Wholesale Seafood Dealer	2
Wholesale Seafood Dealer	4
Total	117

Source: Impact Assessment, Inc. 2005.

Madeira Beach, Florida is an incorporated community with a population of 4,511 reported in the 2000 U.S. Census. *"Madeira Beach is located on a barrier island just west of St. Petersburg and north of John's Pass on Florida's central west coast. The town is one of several beachfront communities in the area with both a well-established population of year-round inhabitants, and a range of services and attractions suitable for tourists and seasonal residents.*

Madeira Beach incorporated in 1947. According to Wilson and McCay (1998) offshore fishing in Madeira Beach began as bandit reel fishing for grouper in the 1960's. There

were two fish houses supported primarily by charter fishing and a small commercial operation. It was during the early 1970's that two vessels began experimenting with long line fishing, but were initially unsuccessful. Later, several vessels began using long lines successfully for swordfish, but as swordfish stocks began to diminish in the Gulf, they were forced to expand their fishing territory to the eastern seaboard. It was on return trips that these vessels began to experiment with long lines in deeper water, thereby discovering an abundance of tilefish and yellow edge grouper. Reportedly, 95 percent of the fishing fleet in Madeira Beach was using long lines (Wilson & McCay 1998). There were four fish houses in Madeira Beach at the time, dealing primarily in grouper, but also swordfish, shark, and other species. Approximately 100 vessels were working from the are during the latter part of the 20th century.

The year 2000 census enumerated 4,511 persons, up from 4,225 in 1990. The community is undergoing change, as waterfront property values rise and condominium development ensues. . The town is sometimes referred to as the "Grouper Capital of the World" as the majority of snapper-grouper in the U.S. is landed here. The fish is an important recreational catch as well. Lucas (2001) reported an estimated 87 long line and 48 bandit reel vessels call Madeira their homeport. Moreover, she found that most captains and crew lived nearby, with over 40 captains living in Madeira, and the rest within 30 minutes away. Overall direct employment, related to vessels and fish houses, was approximately 441 persons in 2000. These numbers are likely less today than in the past, as the number of fish houses and vessels have decreased

.

*With regard to recreational fishing, there are four marinas, including a public marina with over 90 slips. Many residents own their own boat and fish in the Gulf. Support industries do exist, as there are several bait and tackle shops, recreational boat yards, and other related businesses. The community continues to hold the Seafood Festival in October," (*Impact Assessment, Inc., 2005).

Commercial landings reported for Madeira Beach during 2002 were 935,201 lbs and were valued at $1,686,739 ex-vessel. A total of 264 commercial fishing permits were held by persons with an address in the community (15 State permits and 26 Federal Permits). A total of 125 State saltwater licenses were held by persons that reported Madeira Beach as their address on the license.

Table 5.3.3-12. Madeira Beach Demographics

Factor	1990	2000
Total population	4,225	4,511
Gender Ratio M/F (Number)	2,156/2,069	2,376/2,135
Age (Percent of total population)		
Under 18 years of age	8.7	8.2
18 to 64 years of age	65.7	69.8
65 years and over	25.6	22.0
Ethnicity or Race (Number)		
White	4,160	4,378
Black or African American	10	12

American Indian and Alaskan Native	7	14
Asian	32	26
Native Hawaiian and other Pacific Islander	--	2
Some other race	16	30
Two or more races	--	49
Hispanic or Latino (any race)	105	107
Educational Attainment (Population 25 and over)		
Percent with less than 9th grade	4.2	2.6
Percent high school graduate or higher	83.8	87.3
Percent with a Bachelor's degree or higher	19.5	22.2
Language Spoken at Home (Population 5 years and over)		
Percent who speak a language other than English at home	4.5	6.8
Percent who speak English less than very well	1.5	2.0
Household income (Median $)	24,748	36,671
Poverty Status (Percent of population with income below poverty line)	8.4	9.8
Percent female headed household	5.3	5.3
Home Ownership (Number)		
Owner occupied	1,290	1,454
Renter occupied	940	1,074
Value Owner-occupied Housing (Median $)	111,400	171,000
Monthly Contract Rent (Median $)	392	555
Employment Status (Population 16 yrs and over)		
Percent in the labor force	58.5	61.5
Percent of civilian labor force unemployed	2.7	4.4
Occupation** (Percent in workforce)		
Management, professional, and related occupations	--	30.4
Service occupations	--	22.1
Sales and office occupations	--	28.9
Farming, fishing, and forestry occupations	1.4	0.7
Construction, extraction, and maintenance occupations	--	10.6
Production, transportation, and material moving occupations	--	7.2
Industry** (Percent in workforce)		
Agriculture, forestry, fishing and hunting	1.4	0.0†
Manufacturing	7.5	7.0
Percent government workers	8.2	4.5
Commuting to Work (Workers 16 yrs and over)		
Percent in carpools	8.7	14.7
Percent using public transportation	2.2	1.6
Mean travel time to work (minutes)	--	23.1
Percent worked outside of county of residence	10.6	16.0

Source: Impact Assessment, Inc. 2005.

**Differences in the types of data the U.S. Census Bureau used to generate Occupation and Industry percentages in 1990 and 2000 preclude valid comparisons between those census years.

†Year 2000 figures include mining in this group; 1990 figures do not. Mining includes the offshore oil industry workforce.

Table 5.3.3-13. Fishing Infrastructure and Services Observed in Madeira Beach in 2003

Infrastructure or Service	**Quantity**
Air fill stations (diving)	2
Boat yards/ Boat builders (recreational/commercial)	3
Churches with maritime theme	1
Docking facilities (commercial)	4
Fishing Gear, Electronics, Welding, and other repair	4 (2com/2 rec)
Fishing associations (recreational/commercial)	1 (com)
Fish processors, Wholesale Fish House	5
Fisheries research laboratories	0
Fishing monuments/ festivals	1
Fishing pier	0
Hotels/Inns (dockside)	Many
Marine railways/haul out facilities	0
Museums—fishing/marine-related	0
Net makers	0
NOAA Fisheries Service or state fisheries office (port agent, etc.)	0
Public boat ramps	2
Recreational docks/marinas	4
Bait & Tackle/fishing supplies	5
Recreational Fishing Tournaments	0
Sea Grant Extension office	0
Seafood restaurants	Many
Seafood retail markets	2
Trucking operations	1
Site-seeing/pleasure tours	7+
Charter/Head Boats	3+
Commercial Boats	40

Source: Impact Assessment, Inc. 2005.

Table 5.3.3-14. Primary Fishing-related Businesses Listed for Madeira Beach in 2003

Type of Business	**Frequency**
Boat Builder/Broker	3
Boat Rentals & Pier	10
Boat Rentals & Pier- Marina	1
Marina	3
Processor- Wholesale Seafood Dealer	1
Retail/Wholesale Seafood Dealer	1
Total	19

Source: Impact Assessment, Inc. 2005.

5.4 Administrative Environment

5.4.1 Federal Management

5.4.1.1 NOAA Fisheries Service

NOAA Fisheries will be primarily responsible for permitting aquaculture activities within the EEZ. NOAA Fisheries has already implemented a fishery management plan for the culture of live rock and has developed a draft Code of Conduct for Responsible Aquaculture. There is also national legislation pending that would authorize offshore aquaculture permits in the EEZ.

Section 9.0 describes NOAA Fisheries Service authority under the Fish and Wildlife Coordination Act, the Endangered Species Act of 1973, the Essential Fish Habitat provisions of the MSFCMA, the National Environmental Policy Act, and the Marine Mammal Protection Act of 1972,

Additionally, the Council is requesting NOAA Fisheries Service develop regulations pertaining to aquaculture activities for Atlantic HMS in the Gulf of Mexico, as necessary, in consultation with the GMFMC, and consistent with GMFMC fishery management plans to the extent practicable.

5.4.1.2 Gulf of Mexico Fishery Management Council

Regional councils are responsible for preparing, monitoring, and revising management plans for fisheries needing management within their jurisdiction. As marine aquaculture operations constitute fishing under the MSFCMA (C.F.R. § 229.2 1999), the Councils have the authority to make recommendations to NOAA Fisheries about management of marine aquaculture in the EEZ. Fishery management plans will need to be amended by the Councils to accommodate marine aquaculture activities. Under proposed offshore aquaculture legislation (HR 2010), aquaculture would be excluded from the definition of "fishing" and fishery management councils would have a consultative role in the issuance of permits.

5.4.1.3 U.S. Army Corps of Engineers

The ACOE is responsible for issuance of Section 10 permits to offshore aquaculture facilities. The ACOE permitting process is designed to assess the environmental effects of the structure and its aquaculture operations. If the facility is to be constructed on oil or gas structure already permitted by the ACOE, the permit must be revised in this process, the environmental effects shall be assessed under the National Environmental Policy Act (NEPA).

5.4.1.4 U.S. Environmental Protection Agency

Under Section 318 of the Federal Water Pollution Control Act (commonly known as the Clean Water Act), the EPA asserts its jurisdiction to require point source pollution discharge permits for marine aquaculture operations in the open ocean. Appendix H summarizes an EPA rule

establishing wastewater controls for concentrated aquatic animal production facilities, including net pens.

5.4.1.5 Minerals Management Service

The Minerals Management Service has authority to lease sites for minerals development on the outer continental shelf however, transfer of structure ownership from oil and gas lessees to other parties may be regulated. MMS is developing regulations under the authority of the Energy Policy Act of 2005 that would apply to alternate uses of oil and gas platforms, including aquaculture as an alternate use.

5.4.1.5 U.S. Coast Guard

The USCG requires structures be marked with lights and signals to ensure compliance with private aids to navigation (33 C.F.R. 66.01).

5.4.1.6 U.S. Food and Drug Administration

The FDA has jurisdiction over drugs to treat or prevent parasites or diseases of fish, anesthetize aquatic species, or regulate the reproduction of aquatic species. The FDA also regulates therapeutic agents by setting tolerance levels allowed for human consumption and regulates harvest and marketing of shellfish under the National Shellfish Sanitation Program.

The FDA Center for Veterinary Medicine (CVM) approves new animal drugs and animal feeds that may be used in the production of aquaculture fish and shellfish. The FDA requires scientific evaluation of a drug's effectiveness and safety for humans and the environment before approval.

5.4.1.7 U.S. Fish and Wildlife Service

Under the authority of the Fish and Wildlife Coordination Act (16 USC 661) the USFWS may review activities that are authorized, permitted or funded by the federal government and make recommendations to the responsible agencies regarding the interests of fish, wildlife and their habitats. The agency also has regulatory responsibilities under the Endangered Species Act of 1973, the Migratory Bird Treaty Act (MBTA) and the Marine Mammal Protection Act of 1972.

The Lacey Act (16 USC 701) and later amendments, particularly those of 1981 (16 USC 3371-3378) govern the interstate transportation and importation of fish and wildlife and their parts and have some relevance to the introduction of non-native species. The regulations implementing the Act at 50 CFR 16.3 generally prohibit the import into the U.S. of live or dead fish, mollusks or crustaceans unless a permit is obtained from the USFWS at the port of entry (50 CFR 16.13). Permits are generally granted for most species to be imported and held in captivity; except those which have been determined to be injurious. The regulations prohibit the release of imported species into the wild unless done so by a state fisheries agency or persons the agency has authorized to do so. The only species that are strictly prohibited from import are those that have been listed as injurious. The injurious species list currently consists of the walking catfish (family Clariidae), mitten crabs (*Eriocheir* spp), zebra mussels (*Dreissena* spp), numerous species of snakeheads (*Channa* and *Parachanna* spp), silver carp *(Hypophthalmichthys molitrix)*,

and largescale silver carp *(Hypophthalmichthys harmandi)*. There are currently some legal uncertainties regarding application of the Lacey Act in the EEZ.

The USFWS and NOAA co-chair the federal Aquatic Nuisance Species Task Force, which was established under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701) to develop a program of prevention, monitoring, control, and study of aquatic nuisance species. Amendments to the Act authorized the USFWS and NOAA to issue rules and regulations to implement the program as recommended by the Task Force.

In an April 13, 2007 memo, the USFWS stated "there are no regulations under the MBTA requiring a permit, license, or other regulatory approval for the development and operation of open ocean aquaculture facilities as long as those activities do not 'take' migratory birds intentionally or unintentionally." For the purposes of this statement, take means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect. There is no permit available to legalize incidental take of migratory birds under the MBTA; any take incidental to construction or operation of an aquaculture facility would technically be a violation of the MBTA and potentially subject to prosecution.

5.4.2 State Management

The states may comment under the Coastal Zone Management Act.

5.4.2.1 Alabama

The Alabama Marine Resources Division (AMRD) of the Alabama Department of Conservation and Natural Resources (ADCNR) manages Alabama's marine fisheries resources. The AMRD can lease bottoms for culture of oysters and other organisms.

5.4.2.2 Florida

Chapter 597, Florida Aquaculture Policy Act, Florida Statutes, was amended in 1996 to require all Florida aquaculturists to obtain an annual Aquaculture Certificate of Registration and amended again in 1998 to require that certified aquaculturists abide by aquaculture Best Management Practices (BMPs) formulated to preserve environmental integrity. Commercial aquaculturists cannot sell their products unless that possess an Aquaculture Certificate of Registration and include their Certificate number on business related invoice, bill of lading, and reciepts.

The Department of Agriculture and Consumer Services is responsible for BMP development, revision, and farmer compliance. The BMPs are dynamic and subject to revisions driven by technological advancements. The BMPs are a component of Chapter 5L-3, Aquaculture Best Management Practices, Florida Administrative Code, and published by the Department in the form of a manual: http://www.floridaaquaculture.com/publications/P-00104-booklet-07_BMP_RULE.pdf. The Department adopteded the first *Aquaculture Best Management Practices Manual* in 2000 and the fourth and current edition was adopted May 2007.

Florida aquaculturists following the BMPs meet the minimum standards necessary for protecting and maintaining offsite water quality and wildlife habitat. Farms certified through this program as being in compliance with the BMPs are presumed to be in compliance with state ground and surface water standards. The Florida Department of Environmental Protection is not authorized to institute proceedings against any certified facility to recover costs or damages associated with ground or surface water contamination or the evaluation, assessment, or remediation of contaminated ground or surface water.

Florida BMPs were developed and may be created or revised through stakeholder technical advisory committees consisting of farmer, state agency, extension, and environmental group representatives invited by the Department. Subsequent BMPs are subjected to Department review and comment before being submitted to normal state agency rule making processes that include public comment and legislative review.

The *Aquaculture Best Management Practices Manual* consists of: federal permitting; construction; compliance monitoring; shipment, transportation, and sale; water resources; non-native and restricted non-native species; health management; mortality removal; preventing wildlife depredation; chemical and drug handling; marine shrimp; sturgeon culture; shellfish culture; live rock culture; aquatic plants; aquatic animal welfare; and marine net pens and cages. The format is a brief description of the issue followed by a bulleted list of prescriptive and general BMPs.

The Department has created and supported several BMP educational and outreach activities. In concert with the University of Florida, Department of Fisheries and Aquatic Sciences, periodic BMP workshops are held and the agencies jointly developed and installed educational signage that illustrates and describes BMPs at four University of Florida operated aquaculture demonstration and research facilities (shellfish, food and bait fish, shrimp, and ornamental fish and aquatic plants). The Department also publishes a free newsletter, *Florida Aquaculture*, which provides farmers, agencies, legislators and other interested parties notification of BMP development or revision. There are no state dedicated funds to assist farmers with BMP implementation other than technical guidance. The Department of Agriculture and Consumer Services enforces and verifies BMP implementation through unannounced farm inspections. Farms that do not implement or maintain the BMPs are violating state law and are subject to written notice, fines, suspension/revocation of the Aquaculture Certificate of Registration, and potential misdemeanor charges.

Florida has accepted delegation of the Clean Water Act responsibilities from the U.S. Environmental Protection Agency. Concentrated Aquatic Animal Production facilities in the state that exceed EPA's warm water species production and discharge threshold of 100,000 pounds live weight and 30 days must acquire a National Pollution Discharge Elimination System permit from the Florida Department of Environmental Protection (in Florida parlance an Environmental Resource Permit) as well as an annual Aquaculture Certificate of Registration and abide by appropriate BMPs.

According to the Florida Agricultural Statistics Service, in 2005, there were 710 active aquaculture operations, and in 2003, 544. Altogether, Florida aquaculture producers reported sales of $75 million in 2003 and $95.5 million in 2003. They produced tropical fish, aquatic

plants, clams (including clam seed), oysters, shrimp, other fish (hybrid striped bass, koi, largemouth bass, bream, and carp), alligators, catfish, tilapia, other aquatics (crawfish, eels, snails, turtles, crabs, and frogs), and live rock.

Tropical fish are produced in ponds and tanks, and the more prominent species include ornamental favorites, such as guppies, mollies, swordtails, variatus, platies, tetras, gouramies, goldfish, cichlids, barbs, and tropical catfish. Aquatic plants are produced in vats and water surface acres, and include plants for water gardens and aquariums, farm-produced plants used in wetlands restoration, and watercress. Clams, oysters, and live rock are grown in operations that lease state-owned sovereignty submerged land.

5.4.2.3 Louisiana

Louisiana has no regulations for the permitting of offshore aquaculture. As the state entity with the authority and responsibility to manage fisheries in the state, the Louisiana Department of Wildlife and Fisheries (LDWF) would regulate offshore aquaculture as it relates to biological, enforcement, sociological and economic issues of fisheries and the coastal environments that support those fisheries. LDWF currently has authority to permit mariculture in the coastal zone of the state on privately owned property and water bottoms under R.S. 56.579.1. The Platforms for Mariculture Task Force, consisting of state agencies, developed a report in 2005 to the Louisiana Governor examining the economic feasibility of using non-productive oil and gas platforms for sites for aquaculture. The Energy Policy Act of 2005 provides for alternative use of oil and gas platforms for aquaculture.

The Louisiana Legislature enacted the "Louisiana Aquaculture Development Act of 2004", (La. R.S. 3:559.1 et seq). It defines "aquatic livestock" as finfish and crawfish produced, raised, managed, or harvested within or from any private, constructed impoundment that has no inlet from or outlet to any public waters as a segment of agriculture. The Louisiana Aquaculture Coordinating Council (LACC) was established within the Louisiana Department of Agriculture and Forestry (LDAF) under the Act. The LACC provides a regulatory framework for the orderly development and maintenance of a modern aquaculture segment of Louisiana's agriculture industry and for the promotion of aquaculture and aquaculture products.

5.4.2.4 Mississippi

The Mississippi Aquaculture Act of 1988 designates the Mississippi Department of Agriculture and Commerce as the agency responsible for issuing cultivation permits for facilities located "in whole or in part, in the Mississippi Sound, the Gulf of Mexico, or bays or estuaries thereof at such time that such facility complies with all state and federal requirements to protect marine resources" (Miss. Code Ann. § 79-22-17 (1999)). The Mississippi Secretary of State, "upon recommendation of the Mississippi Department of Marine Resources and the Mississippi Department of Environmental Quality may lease waters as provided by Section 29-1-107, Mississippi Code of 1972" (Miss. Code Ann. § 79-22-23(1)). The Mississippi Department of Marine Resources is "authorized to develop a marine aquaculture lease management program and may adopt such rules and regulations as may be necessary to implement the marine aquaculture lease management program and to regulate the growth of aquaculture" (Miss. Code Ann. § 79-22-23(1)). "The Commission on Wildlife, Fisheries, and Parks and the Commission

on Marine Resources may promulgate regulations which specify design criteria to protect the resources within their jurisdiction and to prevent the release of undesirable species from an aquaculture facility into the environment" (Miss. Code Ann. § 79-22-15(5)).

5.4.2.5 Texas

The Texas Aquaculture Code authorizes the Texas Department of Agriculture (TDA) and the Texas Parks and Wildlife Department (TPWD) to adopt rules to carry out the duties of each agency with respect to aquaculture. TDA is the lead agency in charge of regulating aquaculture within the state of Texas and its coastal waters under Texas Agriculture Code § 12 Chapter 134 et seq.

TPWD has regulatory authority over the transport of aquatic products into or within state territory including its coastal zone (TPWD Code § 47.018). TPWD is also charged with establishing the rules and regulations governing the introduction of any aquatic product into public waters (TPWD Code § 66.015) and may lease state bottoms for aquaculture.

5.4.3 Existing opportunities for public comment on aquaculture-related activities

5.4.3.1 Clean Water Act - Administered by EPA

Under Section 318 of the Federal Water Pollution Control Act (commonly known as the Clean Water Act), the EPA asserts its jurisdiction to require point source pollution discharge permits for marine aquaculture operations in the open ocean.

Implementing regulations at 40 CFR 124.10 describe procedures for public notice of permit actions and public comment periods under the Clean Water Act. Public notice must be made of the preparation of a draft permit, and at least 30 days are to be allowed for public comment. The regulations state "all persons, including applicants, who believe any condition of a draft permit is inappropriate or that the director's tentative decision to deny an application, terminate a permit, or prepare a draft permit is inappropriate" must submit information to the Regional Administrator within the public comment period. The Regional Administrator must notify each person who has submitted written public comments of the final permit decision.

5.4.3.2 Magnuson-Stevens Fishery Conservation and Management Act - Administered by NOAA Fisheries Service

Implementing regulations for the Magnuson-Stevens Fishery Conservation and Management Act describe the procedure for issuance of an Exempted Fishing Permit (EFP) (50 CFR 600.745(b)). Public comment is solicited as follows: "If the Regional Administrator or Director determines that any application warrants further consideration, notification of receipt of the application will be published in the FEDERAL REGISTER with a brief description of the proposal, and the intent of NOAA Fisheries Service to issue an EFP. Interested persons will be given a 15- to 45-day opportunity to comment and/or comments will be requested during public testimony at a Council meeting." (50 CFR 600.745(b)). If actions in the subject amendment established a new

aquaculture permitting system, then aquaculturists would not apply for an EFP and this opportunity for public comment on proposed activities would not be applicable.

5.4.3.3 Rivers and Harbors Act - Administered by ACOE

Implementing regulations for Section 203 of the Rivers and Harbors Act of 1899 (33 CFR 325.2(d)) state public notice of a permit application will be issued within 15 days of receipt of all required application information. A 15 to 30 day comment period on the proposed permit begins the date of publication of the public notice. This comment period can be extended up to an additional 30 days if deemed warranted by the district engineer.

5.4.3.4 Energy Policy Act of 2005 - Administered by MMS

The Energy Policy Act of 2005 gives the Secretary of the Interior authority to issue a lease, easement, or right-of-way on the Outer Continental Shelf for activities that use facilities for other (non-energy related) authorized marine-related purposes, such as aquaculture. The MMS published a final Programmatic Environmental Impact Statement in November 2007 which assesses the impacts of allowing the use of energy facilities for non-energy related purposes. The MMS is expected to make a final decision on this action in December 2007. The public will have the opportunity to comment on the proposed rule for this action in 2008.

6.0 Environmental Consequences

6.1 General Description of the Marine Aquaculture Environment

6.1.1 Impacts of Marine Aquaculture on Local Wildstocks

The rapid development of world cage farming of marine fishes has raised concerns over the possible genetic and ecological impact of escaped fish on natural populations. Potential effects include genetic alteration and reduced fitness, competition for food and space, introduction or spread of diseases and parasites, and predation on native stocks.

There is some information available on the intentional release of marine fish species for purposes of stock enhancement, however there are almost no data available on accidental releases (escapees) as applied to marine aquaculture. Intentional releases for stock replenishment or stock enhancement may have positive or negative effects on natural populations by increasing stock size and abundance. Similarly, the effects of accidental releases by species or number may or may not have negative effects. The effect depends on the genetic state of the escaped farm fish and the numbers and mean individual size of the escaped population.

For fishes, whether marine, anadromous or freshwater, the natural genetic variation is partitioned geographically across the range of the species. This universal feature of genetic stock structure in natural fish populations is the need to respond to environmental variability and is generally believed to be important to the long-term survival and fitness of populations within species. These locally adaptive features of fish populations are at risk from interbreeding with fish escaping from aquaculture facilities that are of non-local origin, or local indigenous stocks that have undergone artificial selection or domestication (Youngson *et al* 2001).

Most scientific information on genetic and ecological impacts of escaped farmed fish is found in the scientific literature relating to salmon aquaculture and, although not directly applicable, is the closest approximation available for marine fish species. However, spawning adult salmon are reproductively isolated upon return to their natal streams and, unlike marine species, exhibit highly complex genetic structuring across their geographic range. Nevertheless, because of their long history as cultivars, data from salmon aquaculture and salmon hatcheries often provide the best available scientific information on the possible genetic consequences of marine fish escaping from offshore aquaculture facilities in the United States.

Fishery management in the United States and abroad is based on knowledge of stock structure within a species, with the goal to manage harvest to protect the weakest stock. Today, identifying population structure is essential for good fisheries management and an essential body of information required to assess the impact of escaped aquaculture fish. Large-scale population genetic analysis of marine fish stock structure has accelerated in recent years with the advent of allozyme, microsatellite and mitochondrial DNA polymorphism technology, and at least some genetic stock structure information exists for most finfish species presently in culture.

Naturalization of introduced non-native species that result in invasion and competition with native fauna and flora is recognized as a primary threat to global biodiversity (Wilcove *et al* 1998; Bax *et al* 2001; D'Antonio et al 2001; Olenin 2002). Non-native species have also been shown to be a primary causal factor in the loss of biodiversity of United States biota. The introduction and naturalization of non-native species is believed to be the second most detrimental loss of biodiversity after habitat degradation and loss. Nationwide, about 400 of the 958 (42 percent) species listed as threatened or endangered under the Endangered Species Act are considered to be at risk primarily because of competition with and predation by non-indigenous species.

Invasion of the nation's coastal ecosystems by marine non-native species is accelerating (Grosholz and Ruiz 1996) and species that become invasive have the potential to cause economic damage as well as ecological harm. In marine ecosystems, invasive species have the potential to change community structure, food web dynamics, genetic structure, and in general modify ecosystem processes (Verlaque and Fritayre 1994; Vitousek *et al* 1997; Shiganova 1998; Grosholz *et al* 2000; Semmens *et al* 2004). These fundamental biological changes in ecosystem services can result in degraded habitat, transmission of disease, and ultimately the loss of species through replacement of native species or stocks by the invader.

Most introduced species do not become invasive and documented negative effects of introductions are infrequent. Classification of an introduced species as invasive requires that the non-native species introduction is followed by successful colonization and becomes economically harmful (Williamson and Fitter 1996). However, the unpredictability of the ultimate geographic distribution of a NIS and the potential ecological damage to native biota is cause for concern for a non-native species escaping from aquaculture facilities.

The introduction and naturalization of non-indigenous marine finfish species through human activities may be intentional or inadvertent. Common marine pathways for inadvertent introductions are the dumping of ballast water from distant sites, the aquarium trade (Courtenay

and Robins 1973; Courtenay and Stauffer 1990), culture-based fisheries, and purposeful introductions of a species for creating recreational or commercial fisheries. Aquaculture is also a recognized pathway for both purposeful and inadvertent introduction of non-native species in aquatic ecosystems.

Froese and Pauly (2002) list 1,145 successful finfish introductions worldwide. Of these 241 are marine species. Freshwater fishes appear to be the most invasive and problematic of the introduced finfish species (Zaret and Paine 1973; Goldschmidt et al. 1993). Anadromous fish species, although not as widely introduced as freshwater species, have been successfully introduced into North and South America, and elsewhere. Other examples are the successful introductions of anadromous striped bass and alewives from the eastern United States to the west coast where they have become established in the states of California, Oregon, and Washington.

Fewer marine species are reported to be introduced, and of those successful introductions of tropical marine fish species have been rarely reported (Semmens et al. 2004). Fewer marine introductions may not represent a lower potential for naturalization rather than the lower frequency of attempts to make purposeful introductions.

Between 1955 and 1961 the Hawaiian Islands Division of Fish and Game released 11 species of non-native marine groupers (Serranidae) and snappers (Lutjanidae) to enhance near-shore fisheries of the Hawaiian Islands (Randall 1987). Of these, the peacock grouper (*Cephalophis argus*), the blackfin snapper (*Lutjanus fulvus*), and the bluestriped snapper (*Lutjanus kasmira*) became naturalized, and have now established self-sustaining populations.

Anecdotal information from the tropical western Atlantic indicates that 13 species were intentionally introduced to Bermuda for commercial and game fishing in the 1920s. Of those, *Pomacanthus ciliaris* (queen angelfish), *Pomacanthus arcuatus* (grey angelfish), and *Lutjanus analis* (mutton snapper) have become established (Walford and Wicklund 1973; REEF 2002). In both Hawaii and Bermuda, when significant propagule pressure was applied through intentional or unintentional introductions, exotic fishes have established self-sustaining populations.

Since 1999 divers have reported 16 non-native marine fish species from 32 locales off the East Coast of the United States (REEF Fish Survey), and all of the observed non-native species have been imported in the marine aquarium trade (Semmens et al. 2004). The Indo-Pacific lionfish *Pterois volitans* has apparently been established in marine waters of the southeastern United States (Whitfield et al. 2002). The largest set of intentional marine fish introductions were carried out in the temperate coastal and inland seas of Russia (Baltz 1991). Sixteen species became established, with ecologically and economically devastating results including harm to valuable fisheries, parasite introductions, and the endangerment and extinction of native species (Baltz 1991).

In the past, introductions of turbot have been carried out in the former USSR (FAO 1997), in Iran (Coad 1995), and in Chile for aquaculture purposes (FAO 1997; Pérez *et al* 2003), but with no successful recapture or establishment of breeding populations. However, self-sustaining populations of turbot were successfully introduced in waters around New Zealand (Muus and Nielsen 1999). Experimental releases of cultured fry for stock enhancement purposes have been

performed in Spain (Iglesias and Rodriguez-Ojea 1994), Denmark (Nicolajsen 1993; Støttrup and Paulsen 1998), and Norway (Bergstad and Folkvord 1998).

6.1.1.1 Escapement

With relatively few exceptions, marine fish presently used for aquaculture purposes are genetically and phenotypically close to their wild conspecifics, having been collected directly from wild populations as eggs or juveniles, or derived from wild broodstock which are spawned in captivity. While these practices minimize the immediate risks to the genetic makeup of local populations, large scale aquaculture programs inevitably require continuous and dependable supplies of juveniles which can only be obtained from hatcheries.

Several factors merit consideration when evaluating the likely ecological, environmental, and genetic impacts cultured fish may have should they escape. Among them are the natural population genetic structure and phenotypic variability of the stock; the size of the stock relative to the estimated number and frequency of escapement; the type of breeding program to be used, including selection of the founding stock; and the likelihood that unintentional genetic drift (domestication) related to hatchery practices will occur. Also, the economic imperative to improve stock performance (growth rate, disease resistance) through selective breeding may decrease the genetic diversity of farmed strains compared with their wild counterparts. Natural mating of farmed fish and wild fish conspecifics has been documented, leading to alterations in the local genetic structure (Alarcon et al. 2004; Perez-Enriquez et al. 2001). However, these changes are not necessarily deleterious even when farmed fish greatly outnumber their wild counterparts.

6.1.1.2 Genetic Diversity

One outcome of introducing closely related species is the potential for interspecific hybridization leading to endogeneous selection against hybrids through loss of fitness, and reduced population size of the contributing species (Barton and Hewitt 1985; Campton 1987; Gardner 1997; Rao and Lakshmi 1999). The prevailing view has been that natural hybridization is an evolutionary dead end, because hybrids could generally never do better than parental types (e.g. Barton and Hewitt 1985).

Recently, natural hybridization has been seen to occur in a few more marine species (Roques et al. 2001) along with the view that narrow hybrid zones between species have little consequence on the genetic integrity of the parental species (Barton 1979; Barton and Hewitt 1985 and 1989; Hewitt 1988). It has been suggested that introgressive hybridization may sometimes be a rich source of genetic variability important to the evolution of new species (Arnold 1992; Martin and Cruzan 1999). Athough the first hybrid generation may be more robust and superior in some aspects to either parent species, reduced fitness can be a long-term result, a phenomenon referred to as outbreeding depression. This may occur due to loss of adaptation to specific habitats and disruption of coadapted gene complexes, potentially resulting in reductions in growth, survival, fertility, thermal tolerance, or homing (Leary et al.1995). Nevertheless, an example of natural hybridization and naturally occurring ocean hybrid zones are still rare, and controversial, and the genetic consequences of hybridization unknown. Therefore, the consequences of hybridization

between escaped farmed fish and closely related natural species are still generally unknown and should be avoided.

6.1.1.3 Competition

Extinctions of long-term resident species resulting from the introduction of predators or pathogens into spatially-restricted environments such as islands or lakes, or by habitat alterations are well documented in the scientific literature. For example, predation by brown tree snakes *(Boiga irregularis),* introduced to Guam in the Mariana Islands during the last half of the twentieth century, caused the extirpation or serious reduction of most of the island's 25 resident bird species (Wiles et al. 2003). A community of over 400 fish species occupying Lake Victoria (Africa) collapsed to three co-dominant species in just 11 years following a staggered series of irruptions in the population of Nile perch *(Lates niloticus)*, an introduced species. The extirpation of fish species at virtually all trophic levels may have further intensified eutrophication of the lake by decoupling the internal nutrient cycling and export system (Kaufman 1992). These habitat alterations have furthermore decreased the range (and population size) of the few native species that remain.

While intertrophic interactions such as those cited above clearly can have profound ecological effects, including extirpation or extinction, competition between species at the same trophic level (controphic interactions) are often limited to changes in the dominance-abundance of a community (Davis 2003). To illustrate, the construction of the Suez Canal in 1869 permitted a sudden, large scale mixing of the formerly isolated marine biota of Mediterranean Sea and Red Sea. As described by Mooney and Cleland (2001), the introduction of over 250 species, 34 new genera, and 13 new families into the Mediterranean Sea has resulted in only one documented extinction. Niche displacement through competitive interactions among congeners has occurred, with native Mediterranean species adjusting their foraging depth distributions to accommodate the colonizing species (Golani 1993). Nevertheless, some confamiliar indigenous species have nearly disappeared from local catches, having been replaced by Red Sea species that occupy similar habitats (Golani 1998).

Deleterious changes in marine fish assemblages resulting from aquaculture development (and the corresponding introduction of non-native species) have been suggested, but not confirmed, by scientific studies. Conversely, a long-term study (1984-2001) comparing icthyofauna of the sandy shore of the Northern Red Sea assessing fish assemblages before the commencement of marine aquaculture, during the buildup phase (<100 tonnes per annum), and during full production (2000 tonnes per annum) found no significant change in number of individuals, number of species, biomass per sample, or cumulative number of species (Golani and Lerner 2007).

6.1.2 Aquatic Animal Health

6.1.2.1 Infectious Disease Interactions between Wild and Farmed Fish

Water moves freely between farmed fish in cages/pens and the open marine environment. Outbreaks of disease have been observed in farmed fish. Further, escapes have occurred from farms where disease events may be occurring. There is no scientific evidence to suggest a

significant risk of disease transmission from farmed aquatic animals to wild populations or from escaping farmed aquatic animals inter-mingling with wild stocks when the farmed fish start with disease free juveniles stocked in ponds or pens.

Like terrestrial animals and humans, aquatic animals, such as fish, mollusks, and crustaceans, can become sick due to infectious diseases. Disease is a complex process that involves a pathogen (a disease-causing agent such as virus, bacteria, or parasite), a susceptible host (fish or shellfish), a sufficient number or "dose" of pathogens to overcome the immune system of the aquatic animal in order to cause disease, and an aquatic environment that favors the pathogen and/or stresses the susceptible host. Wild and cultured aquatic animals are known to experience stress due to a variety of causes and this may increase their susceptibility to sickness.

Both wild and farmed aquatic animals alike are constantly exposed to pathogens in the aquatic environment. These pathogens are part of the natural fauna and although wild marine organisms typically serve as carriers of these pathogens, disease actually occurs only when the pathogen overcomes its host's immune system; for example, humans are frequent carriers of *Streptococci* in their throats and influenza in their noses, but unless their immune systems are compromised in some way, they do not become sick.

Experience with commercial production of non-salmonid marine fish in hatcheries and open ocean systems in the United States is limited, though experiences in New Hampshire, Hawaii and Puerto Rico are increasing the existing knowledge base. On the other hand, this type of aquaculture has been practiced for many years in many countries in Asia and Europe and the U.S. has over forty years of experience working with salmon in open water marine pens. At commercial salmon hatcheries, juveniles are reared in fresh water typically from springs or wells which minimize exposure to serious diseases. Before transfer to saltwater the fish are required by the laws of the States of Washington and Maine to be free of certain diseases. Other States, such as Texas and Florida, require that transfers of fish are carried out under the auspices of a permit issued by the State. Conditions can then be placed in these permits that would require pre-transfer inspections for disease.

After transfer to marine pens fish may be exposed to the pathogens existing in the environment. Because of the relatively high fish densities that are typical in cages or pens it is possible for pathogens to spread through the captive population and multiply sufficiently to cause an outbreak of disease. The trigger for these outbreaks may be alterations in environmental conditions (e.g. temperature), or perhaps handling during farm operations. There are no data to indicate that diseases that have occurred in marine fish farms in North America have been a pathway for the introduction of foreign or exotic diseases. Further, studies have shown that within a few meters of a marine net-pen experiencing a disease outbreak levels of pathogens shed are rapidly diluted – likely diluted to doses that are insufficient to initiate infections in healthy wild or farmed fish (Rose *et al* 1989).

Observations and mathematical models developed by Canadian researchers (Morton et al. 2005; Krkosek et al. 2005) suggest that salmon farms in British Columbia have shed sea lice to the extent of causing significant infections in wild juvenile Pacific salmon. These authors have further postulated that the marine salmon farms are responsible for depressions in the wild salmon populations, to include the low return of adult pink salmon (*Oncorhynchus gorbuscha*) to

the Broughton Archipelago. These assertions were made without data on the actual prevalence of sea lice on the salmon farms and without consideration of alternative hosts such as wild non-salmonid marine species serving as a source of infection for the wild salmon. Subsequent published reports provide data that demonstrate wild three-spine stickleback (*Gasterosteus aculeatus*) are carriers of sea lice (Jones et al. 2006), information that levels of lice fluctuate significantly year to year due to climatic conditions, currents, and salinity of seawater (Brooks 2005), and that wild salmon populations and farmed salmon can coexist successfully in the marine waters of British Columbia, Canada (Beamish et al, 2006). These most recent scientific studies appear to refute the conclusions of Morton et al. 2005, and Krkosek et al. 2005.

Disease outbreaks also occur in populations of wild aquatic animals. Significant disease events have been observed when large numbers of wild fish aggregate, such as at spawning time, or when there are stressful environmental conditions like prolonged elevated water temperatures in the summer; for example, an outbreak of viral hemorrhagic septicemia, a naturally-occurring disease in marine waters, caused significant mortality in wild pilchard and herring in the northeast Pacific Ocean (Traxler et al. 1999).

The transfer of pathogens from one geographic region to another via the intentional or natural movement of fish or shellfish is possible. One example is the white spot syndrome virus (WSSV) in live shrimp transferred from Asia to South America. This introduction was caused by illegal movements of shrimp and improper health inspections prior to legal shipments. Another example is the accidental introduction by the government of Norway of the parasite *Gyrodactylus salaris (G. salaris)* from the Baltic Sea region in Sweden to Norway. This introduction occurred due to inadequate health inspections prior to transfer of the juvenile salmon. Although the United States currently has regulations governing the interstate movement of or preventing some pathogens from entering the country, those regulations only address the importation of salmonid species and their gametes and certain of their associated pathogens (50 CFR 16.13(a)(3). There are no current regulations governing the movement of pathogens associated with other fish families. In recent years the Animal and Plant Health Inspection Service (APHIS), NOAA, and USFWS have been tasked with developing a National Aquatic Animal Health Policy by the Joint Subcommittee for Aquaculture. This document is supposed to address issues of importation of all aquatic species and associated pathogens of concern, although such general importation legislative authorities and regulations have not yet been developed. The APHIS recently placed restrictions on interstate movement of aquaculture animals infected with certain viral pathogens and parasites, and some states have authority over aquaculture pathogens within their borders. There are no current regulations governing aquatic pathogens in the EEZ, although steps are currently being taken by both the United States and Canada to strengthen protective measures by augmenting their respective aquatic animal health policies and regulations.

Escape of farmed fish from marine net-pens is well documented. However, the ability of such escapees to spread disease to wild aquatic animals is thought to be limited because many of the farmed fish quickly become easy victims of predators. Should escapees be carrying a disease agent, the likelihood of their being the principal source of an outbreak in wild fish is remote because (i) any pathogens they carry are typically those to which the wild fish are routinely exposed; (ii) escapees are unlikely to generate enough infection pressure to result in disease in a healthy wild stock, and (iii) environmental factors play a larger role in triggering a disease event

than does the mere presence of a pathogen (Amos and Appleby 2001, and Amos and Olivier 2001).

In summary, the risk of transfer of disease from farmed fish to wild aquatic animals is low. There are examples of exotic diseases introduced by farmed aquatic animals resulting in disease events in native wild animals and other farmed animals, as in the case of *G. salaris* in Norway and WSSV in shrimp in South America. Disease outbreaks occur in both wild and farmed aquatic animals, but there is little scientific data to link disease episodes in wild populations to farmed animals, with the exceptions of exotic/foreign diseases. Notable exotic disease introductions by farmed aquatic animals have been the result of inadequate health inspections or illegal imports. Infectious diseases can be prevented or controlled at farms. Vaccines play an important role in protecting farmed fish from disease.

6.1.2.2 Therapies to Prevent and Control Infectious Diseases

Infectious diseases in cultured marine animals can result in mortality and decreased efficiencies in production due to slowed or altered growth patterns. To prevent or control infectious disease events the primary tools used by culturists are biologics (vaccines), antimicrobials such as antibiotics, external therapies such as drugs/chemicals that are applied via the aqueous rearing environment of the animal, and good or 'best management practices' (BMPs).

The most common biologics used for farmed fish are vaccines. Similar to vaccines used in human and terrestrial animal medicine, vaccines are injected into the host and the host subsequently develops immunity from the specific disease for which the vaccine was prepared. In finfish aquaculture, vaccines have been successfully used to prevent a variety of bacterial diseases, including vibriosis and furunculosis, and some viral diseases such as IHN and ISA. Scientific studies are in progress to develop vaccines for external parasites. All vaccines for use on fish destined for human consumption must be approved by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Agency – the federal agency responsible for regulating animal biologics. These approved vaccines have been determined by the USDA to be safe and effective for the aquatic host being vaccinated, and safe for the environment and the human consumer.

Antimicrobials are compounds used to treat animals that are infected with pathogens. The most common of the antimicrobials used in finfish aquaculture are antibiotics. Antibiotics are also used in human and animal medicine. Their primary function is to treat diseases caused by bacteria. They function as bacteriostats (stop the bacteria from effectively reproducing in the host), or as bactericides (kill the bacteria in the host). All antibiotics used in the United States for animals must be approved for use by the U.S. Food and Drug Administration (FDA), Center for Veterinary Medicine. Before an antibiotic is approved for use it must be evaluated for target animal safety, efficacy, human food safety, and environmental safety. The FDA approval process takes several years and costs millions of dollars. Currently, there are three antibiotics approved for use in finfish. Antibiotics are applied by either as an ingredient of the feed or by an injection. Regardless of route of administration, careful guidelines must be followed for dose and withdrawal times. Prescription and the administration of antibiotics are made at the direction of a licensed veterinarian.

There is a concern by some that antibiotics in uneaten fish food may pass through nets, settle to the benthos, and potentially impact resident organisms. A concern has been raised that the potential exists for these antibiotic residues to induce drug-resistant strains of human pathogens. Studies indicate that oxytetracycline may persist in sediments below pens for a period of time but there is no indication that these residues have had long-term negative impacts on the environment or have caused human health problems. Globally, the use of vaccines to prevent bacterial diseases has in the past twenty years reduced the use of antibiotics in marine farming by 95 percent.

Another type of drugs applied to fish are compounds to kill parasites. Sometimes these compounds are applied in the feed while in others they are applied as a bath to kill external parasites or bacteria on the skin of the fish. Like antimicrobials, use of these compounds depends on approval by the FDA or the Environmental Protection Agency – EPA (EPA is the lead federal agency if the compound is a pesticide and not a drug) and must be effective, safe for the host, safe for humans, and safe for the environment.

6.1.2.3 Measures to Protect the Health of Wild and Cultured Stocks

Prevention is the preferred method to deal with aquatic animal health issues. Three approaches need to be considered: 1) use of good management practices/BMPs by the fish culturist; 2) an ongoing fish health monitoring program by an aquatic animal health specialist; and, 3) a regulatory structure that supports aquaculture and wild stocks by preventing the introduction and dissemination of foreign or exotic diseases.

The fish farmer is the primary health giver for cultured animals. Attention must be given to providing bio-security to the culture site, practicing appropriate sanitary measures and following good management practices for fish culture. These practices include rapid removal of mortality, appropriate rearing densities, good record keeping, and working with an aquatic animal health expert in developing and implementing the health program.

The aquatic health specialist, often a veterinarian, is responsible for regular observations and examinations of the fish, using preventative measures, such as vaccines, directing the use of approved drugs as appropriate and notifying government officials upon discovery of a serious or 'reportable' disease.

The third leg of the prevention stool is policies and regulations administered by State and Federal agencies. USDA/APHIS is the lead federal agency responsible for the health of all farmed animals. NOAA Fisheries and the U.S. Fish and Wildlife Service are the federal agencies that share responsibility for wild and feral aquatic animals. All three agencies work closely with States and Tribes that also have their respective aquatic health polices and regulations. Historically, States have been effective in developing and implementing regulations to prevent the introduction of exotic diseases. Since 2002, when the Animal Health Act was passed by Congress, USDA/APHIS has initiated programs to address the import of diseases of concern. In cooperation and collaboration with APHIS, NOAA Fisheries and the Fish and Wildlife Service are developing a national aquatic animal health plan. This plan is scheduled to be completed this summer with implementation to follow as resources allow. By utilizing all three mechanisms to

manage aquatic diseases, the experiences of introducing or spreading serious diseases, such as the Norwegian experience with *G. salaries*, should be avoided.

6.1.3 Effluents from Marine Fish Culture Facilities

6.1.3.1 Effects on Benthos from Solids and Dissolved Nutrients

The responsibilities of the United States Environmental Protection Agency (EPA) include regulation of the country's coastal and offshore marine environments. For many years the Agency has continued to set parameters, both onshore and offshore, in which industries may operate. One is the marine aquaculture industry, and regulations are imposed through National Pollution Discharge and Elimination System (NPDES) permits. The environments essential to fish habitats are managed by the Magnuson-Stevens Reauthorization Act of 2006 (MSFCMA), which continues to manage the fisheries and promote conservation., and the recently introduced National Offshore Aquaculture Act of 2007 (Appendix B) is designed to produce economic benefits and food production while ensuring the development of regulatory standards to protect marine ecosystems.

Today, concentrated aquatic animal production facilities, or marine fish farms, are being planned for operation much further offshore, and specifically inside the Exclusive Economic Zone (EEZ) of 3-200 miles. Consequently the effects of fish and shellfish farms in the deep water environments are significantly fewer than those near-shore, and have significantly less impacts. Primarily this is because the cumulative impacts of any uneaten feed and fish feces are significantly lower as these products are rapidly dissipated or consumed by a variety of marine species without concentrating their numbers and accumulating farm impacts. Secondly, the deep water enables a clustering of cages or crops so that it possible to consider a concentration of grow-out units and farms. With all the potentials for the benefits of depth, lay-out, and use of farm effluents, operations in deep water offshore have few environmental consequences.

It is practical and possible for NOAA to propose quality standards for the protection of marine ecosystems in the vicinity of aquaculture sites. These are being selected carefully and guided by effluent limitations and new source performance standards for the concentrated aquatic animal production point source category (Clean Water Act 2004); by ongoing national studies (NOAA 2001), general guidelines (Cole et al. 1999), and research and development by universities, such as New Hampshire, and private farms in Hawaii and Puerto Rico. Primarily the current standards are the most qualitative. Marine farms in coastal waters, mostly for fish species, have been in existence all over the world for many years. Their impacts on their immediate environment have been measured and monitored continuously for respective regulatory authorities, and many sites have been the focus of innumerable ongoing research programs. Consequently experience now shows that some parameters are much more indicative of meaningful changes in the conditions of the environment than others, and these are proposed for management.

Secondly the standards are quantitative. Again, because of the accumulation of data regarding environmental change over time, most of which has been faithfully documented in scientific and technical literature, numerical levels of these parameters at which risks to the environment are becoming no longer acceptable are now identifiable, and it is these levels which are proposed.

And finally, the procedures to measure the standards are relatively straightforward and inexpensive to carry out. Consequently it is intended that the parameters proposed are monitored frequently during the routine operations at any site, and do not impose any unnecessary or restrictive financial burden.

The relevant perceived risks of the field of marine fish culture as identified by international experts are divided into eight main categories (Nash et al. 2005). The two most important are (i) the risks of increased organic loading on the benthos, and (ii) the nutrient enrichment of the water column. The effects of organic effluents to and from the fish farm environments have been studied now for some forty years. Consequently the assessments of risks of fish farming and management have been summarized already by many individuals for country organizations. These include, individuals, such as Hargrave et al. (1997), Hambrey and Southall (2002), Levings et al. (2002), Brooks and Mahnken (2003), and Pérez et al. (2003); by many national organizations, such as the Scottish Executive Central Research Unit (2002), the British Columbia Ministry of Water, Air, and Land Protection (MWLAP 2002); and by global organizations, such as the International Council for the Exploration of the Sea (ICES 2002 - 2004).

A review of these risk assessments show that the majority of effects are based on the past and current farming practices for Atlantic salmon in specific countries, and only a few other marine fish. These assessments are by many countries specifically relevant to their coastal environments; for example, aquaculture in the fjords of Norway (Maroni 2000; Kutti et al. 2007, and 2007b); among the islands of the west coast of Scotland (SEPA 2000, and SEPA 2005), in the cold waters of Sweden (Ackefors 2000) and Finland (Varjopuro et al. 2000); and south in Australia and Tasmania (ANZECC 1992, Walker and Waring 1998, and Macleod and Forbes 2004). Most of the standards of marine fish culture which have emerged are based on the Norwegian and Scottish experiences and long-established data-bases, and have been summarized for Europe by Fernandes et al. (2001), Fernandes and Read (2001), and Henderson and Davies (2001). However, it is necessary to remember that the farming areas around both Scandinavia and Europe currently are quite shallow as the net-pens are relatively close to shore. Further, the EPA has developed NPDES standards for fish farms in the U.S.

Four standards are recognized as the key indicators of change and potential environmental impact in and around an aquaculture site. These are:

(i) Total volatile solids (TVS) in the sediment,
(ii) The redox potential (eH) of the sediment,
(iii) The presence of soluble hydrogen sulfide (free sulfide) in the sediment,
(iv) Dissolved inorganic nutrients, nitrogen and phosphorus, in the water column.

TVS is an alternative measure of the suspended or dissolved organic matter in any aquatic habitat which is volatile. It is a good but crude indicator of the biological and chemical effects in the sediments beneath and around fish farms, and is the preferred indicator for monitoring the benthic impact of any fish farm. Determination of the redox potential (eH) in the sediment beneath and around a farm site provides an accurate indication of its stability and quality, and the reduction and oxidation characteristics of the sediment. The increased concentration of sulfides on the sediment beneath fish farms is another consequence of the continuous deposition and degradation of organic wastes. In such anaerobic conditions, these wastes are rapidly

metabolized by the reduction of sulfates to sulfides by bacteria. Finally, it is important to prevent the development of noxious conditions above the substrate for the epifauna. In addition to toxicity such conditions can lead to eutrophication, resulting in concomitant reductions in dissolved oxygen levels or production of harmful algal blooms.

There are four optional standards which are useful indicators of some changes occurring in the environment. However, these are not imperative to determine every time as they do not provide information that cannot be deduced from the four priority standards. These four secondary standards are:

Dissolved oxygen levels in the water column,
The presence of chlorophyll-a,
The acidity or alkalinity (pH) of the water column, and
Suspended solids.

The purpose for the standard of dissolved oxygen levels in the marine water column is to prevent the development of anoxic conditions which would impair the physiological processes and metabolism of aquatic organisms, and to maintain the natural balance of species populations within the ecosystem. Chlorophyll-a is a plant pigment used to determine the amount of algal biomass, or standing stock of phytoplankton, present in a body of water. Excessive amounts of chlorophyll-a indicate an algal bloom that may reduce water clarity and may result in depleted oxygen levels; therefore the algal bloom conditions are defined by routine chlorophyll measurements.

Recent environmental monitoring studies conducted off Puerto Rico and New Hampshire indicate benthic and organic loading tends to be fairly localized around open-ocean aquaculture cages (Alston et al. 2005; Rapp 2006; UNH 2006). Alston et al. (2005) conducted bimonthly chemical and macroinvertebrate sampling at a control site and sites 0, 20, and 40 meters away from two cages off the coast of Puerto Rico in 2002 and 2003. There were no significant differences among sampling sites in ammonia-N, nitrate-N, nitrite-N, or phosphate concentrations in the water column, organic matter or organic nitrogen in the sediments, organic nitrogen beneath the cages, organic matter among sampling stations, and total carbon beneath the cages (Alston et al. 2005).

Rapp (2006) conducted additional environmental monitoring at the same fish cage assessed in the Alston et al. (2006) study. This study was conducted for 15 consecutive months in 2004 through 2005. Organic and benthic loading was measured at four stations along a transect extending from immediately under the cage out to 100 m away from the cage. No organic loading in the benthic water was observed for the first seven months of the study. In the eighth month of the study and thereafter an increase in benthic water organic loading was observed. This increase was attributed to a change in composition and integrity of the fish feed (Rapp 2006). The study reported no increase in organic loading in the sediment for the duration of the project. Organic loading in the water column did not integrate into the sediment because of the composition of the sediment ($CaCO_3$) and high current speeds near the benthos (Rapp 2006).

Since the late 1990s research has also been conducted at experimental aquaculture cages off the coast of New Hampshire (UNH Marine Aquaculture Center 2006). A series of sampling sites

surrounding the cages was used to monitor water quality and benthic sediments. Since 1997, no change in the particulate organic content of bottom sediments has occurred (UNH Marine Aquaculture Center 2006). There is also no evidence of aquaculture activities affecting water quality parameters (e.g., suspended sediments, chlorophyll, and dissolved oxygen). Dissolved oxygen did decline near the bottom in fall 2006, but this decline was attributed to cooling of the water column and annual variations in dissolved oxygen in the Gulf of Maine region. Pollution intolerant benthic taxa represented a majority of taxa at sampling sites and there were no discernable trends among study sites. The study also examined diversity and species evenness indices, and no discernable differences in benthic taxa (pollution tolerant vs. intolerant) were determined among study sites. The study did indicate, however, that marginally significant lower means for total community taxa in impact zones surrounding the cages may be early signs of increased organic loading. Additional monitoring is now ongoing.

6.1.4 Physical Interaction with Marine Wildlife

There are a number of physical interfaces of aquaculture facilities and activities on marine wildlife. The specific sources which pose potential risks to marine wildlife include any floating or submerged structures themselves, any nets, ropes, anchor lines, and anchors associated with any structures; any garbage carelessly lost by a farm; and artificial lighting. The route of exposure of any physical interaction between marine aquaculture and migratory wildlife is simply the existence of aquaculture structures in their migratory pathways, or in their target habitats such as feeding grounds or breeding grounds. Physical interaction with marine wildlife can result in entanglement in nets in place, structures, and/or moorings etc; entanglement with lost nets and other jetsam; attraction of wildlife species disrupting the natural patterns of migrants or displacing them from an area, and predator control methods.

Based on experience from operational facilities in Hawaii, New Hampshire, and Puerto Rico, interactions with marine wildlife appear to be minimal with no negative effects. Using on-site monitoring, no effects have been seen with marine mammals in Hawaii or Puerto Rico; the only noticeable problem was shark interactions in the Bahamas because of poor management practices in removing mortalitites in a timely manner from pens.

Nash et al. (2005) included a template that outlines an approach for conducting a risk assessment for physical interactions with marine wildlife, as well as ways to reduce the potential risks to very low levels. Information applicable to offshore aquaculture in the Gulf of Mexico is provided in the following subsections.

6.1.4.1 Entanglement

Marine aquaculture activities in offshore environments pose a potential risk to wildlife because the facilities incorporate structures that use nets, ropes, or twine, all of which may be opportunities for their entrapment and entanglement. Of particular danger to marine mammals and turtles for entanglement are lines or ropes that are small in diameter, slack in the water, and possibly floating near the surface. Drowning after entrapment in or around a netted structure is a possible cause of loss, together with starvation following entanglement or consumption of discarded or lost debris from a farm, such as a piece of rope or plastic.

In the Gulf of Mexico, offshore dolphins pose the greatest risk of physical interactions with aquaculture facilities because they are more likely to remain around facilities than more migratory species. Reports in Australia and New Zealand document bottlenose dolphin drowns resulting from sea pen entanglement. Offshore facilities in New Zealand also have documented marine mammal entanglements.

All five species of sea turtles risk entanglement because of their migratory nature. Although there no published reports of sea turtles being entangled in aquaculture facilities, leatherback sea turtles are the most likely to be become entangled or impacted by debris from facilities. This is because in addition to their pelagic offshore nature, their susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on lines kept in the water. Section 5.2.2.3 provides a list of species currently considered by the MMPA and ESA for the Gulf and the potential actions to determine the impact of aquaculture on these species.

Despite the potential risks, entanglements are unlikely if anchor lines and nets are kept taut at all times.

Since 1997, the University of New Hampshire has been monitoring marine turtles and mammals at an offshore aquaculture site near the Isle of Shoals. No interactions have occurred between during the course of the research project, although whales have been observed in the vicinity of the research site (UNH Marine Aquaculture Center 2006).

NOAA Fisheries' Office of Protected Resources conducted a workshop to identify ways to avoid or minimize interactions between aquaculture operations and marine mammals and turtles.[1] Potential permit requirements may include inspections of the facility via SCUBA and/or boat surveys by observers experienced in the collection of information on the presence of any listed species or marine mammals in the area. Weather permitting, daily inspection of net pens or cages may be required, independent of whether or not the stocked fish are present to collect information on the presence of marine mammals or listed species in the area of the facility and to document any interactions with listed species or any marine mammal. Reporting requirements such as monthly survey reports may also be specified. Information for each listed species and marine mammal observation may include: date, time, location of sighting on track line (either latitude or longitude or LORAN), visibility (distance), weather/cloud cover, sea state (use Beaufort scale), species and number of any observed listed species or marine mammals, approximate location of animals relative to vessel (distance and bearing), duration of sighting, (i.e., how long a particular animal or group of animals was observed), brief description of observed behaviors (feeding, diving, resting, breaching, etc.), description of interaction with net pen, a diagram of the actual track line followed, and the time the survey began and ended.

6.1.4.2 Attraction of Wildlife

Wildlife may be attracted to aquaculture facilities as potential sources of food, shelter, and rest. A large cross section of marine wildlife is attracted to floating or submerged structures. Marine

[1] NMFS 1999

structures are primarily habitats where food can be found, and a place for rest and shelter. Fish aggregate in numbers to feed on smaller aquatic animals and plants that colonize around and on the structures. In other cases, wildlife may simply find them to be an obstruction in a migratory pathway or in a breeding area. Wildlife not necessarily close to a facility may also try to eat or play with garbage that has been lost from the facility.

Around structures close to the shoreline, marine mammals and birds are common visitors. The attraction is not just the chance opportunity to feed on the fish and shellfish being farmed, together with their feed, but the other wildlife attracted to the area. Further offshore, the more common wildlife visitors focused on food are predatory elasmobranchs, such as sharks. The providing of food and the very presence of fish being cultivated may also serve as powerful attractants to marine mammals and birds that normally feed on similar or the same fish stocks in nature. Birds can potentially be entangled in nets while trying to feed on fish enclosed by the nets and drown. Above-surface lights on aquaculture facilities may also attract nocturnal birds to the facilities and thereby subject them to potential injury or death due to collision or entanglement with exposed structures. Exposed wiring and cables pose particular hazards to birds due to potential collision with and entanglement in them. Reference by applicants to the USFWS guidelines for design and placement of communication towers, available on the USFWS web site (www.fws.gov) may help in minimizing harmful interactions with birds at aquaculture facilities. There are also visitors by chance, such as whales, porpoises, and migratory marine turtles looking for shelter and rest.

Aggregation of birds and fish around structures pose the risk of changes to animal or bird foraging and migration patterns.

Aquaculture structures are typically fitted with one or two light units during winter months. However, the lights are secured in place about 4-5 m above the bottom, in order to create an effective of 10 lx (about 1 ft candle) in the furthest corner. This is weak to begin with, and in temperate waters is attenuated to 1 percent within 10-20 m from the perimeter of the net-pen, and less when the net is beginning to accumulate bio-fouling organisms. Therefore the risk of such lighting directly impacting the out-migration of juvenile fish, or attracting forage fish and predators significantly is very low to begin with. Moreover, net-pen complexes are in waters up to 40 m deep, and only larger juveniles would have the opportunity to interact with a complex, and when out-migrations are taking place and forage fish are active (usually in the spring and early summer) the use of the lights is <8 hours followed by a >16 hours interval of natural light which is not long enough to encourage them to stay for more than a few hours.

Visual surveys conducted before and after installation of sea cages at Snapperfarm's aquaculture site in Puerto Rico indicate both species richness and abundance of wild species increased after deployment of cages (Alston et al. 2005). The cages acted as fish aggregating devices, with most fish (> 90 percent) attracted to the site belonging to the jack family (Alston et al. 2005). Additionally, a decrease in benthic macroinvertebrates was observed immediately beneath the cages when compared to control sites.

The University of New Hampshire has conducted 15 videography cruises since 2002 to track changes in benthic epifauna around several experimental aquaculture cages (UNH Marine Aquaculture Center 2006). Some differences in the total number of species were observed

between spring and fall 2006. An increase in the number of northern sea stars surrounding the cages was observed and partially attributed to cleaning of biofouling from the fish cages and strong storm activity, which exposed additional food sources. Once the short-term supply of food resulting from the cleaning of the cages had dissipated, the northern sea stars dispersed.

6.1.4.3 Predator Control

As noted previously, predators may be attracted to marine aquaculture sites since they supply and abundant source of food. Most of the literature to date concerning nuisance predators has focused on pinnipeds (seals, sea lions), which do not occur in the Gulf of Mexico. In the Gulf of Mexico, sharks and offshore bottlenose dolphins stocks are likely to be the most common predators.

To curb predation, many marine fish farms worldwide employ control methods which exclude, harass, or remove predators. One such method, predator netting, creates a barrier which protects farmed fish from attacks by airborne or under water predators. Commercial acoustic deterrents have not proved to be effective against any of these visitors, as both animals and birds quickly get used to them, and for the most part they are no longer used or are prohibited by law.

Shark predation has led to major production loss in the Bahamas (Bennetti, pers. comm.). Collaboration with other institutions and the private sector, a major effort is currently being placed on anti-predator systems, including predator nets, solid barriers, electromagnetic and magnetic fields and chemical and electrical repellants to address shark predation.

Cetaceans have not been reported to consume fish or shellfish out of farms, but have been known to get entangled in equipment, resulting, in addition to self injury, damage to gear and release of fish. Dolphin predation is more problematic because of their protected status and ability to quickly adapt.

6.1.5 Competing Uses

The development of offshore aquaculture will require the production facility to have exclusive access to the portion of the ocean where they operate. The exclusive use of an area means that the offshore aquaculture firms will compete for space in federal waters with other activities[23] (Cicin-Sain et al. 2001). Because various users are competing for the same area of the ocean, it is important to consider the interactions of various user groups during the permitting process (Rieser, 1998).

In the Gulf of Mexico, aquaculture firms will primarily compete with commercial and recreational fishers and with commercial vessels and recreational boaters for navigable waters. When considering offshore aquaculture, Knapp (2006) concluded that fewer direct conflicts with other users would be realized relative to nearshore aquaculture. Finally, as discussed in more detail in Section 7, the amount of open space occupied by offshore aquaculture facilities is likely

23 For example, navigation, fishing, offshore oil development, military activities, recreation, and conservation

to be exceedingly limited in relation to the total amount of available space. This would suggest that conflicts with competing uses may be relatively minor.

The following sections discuss some of these potential conflicts of this proposed EIS and the objectives of other federal, regional, and state resource use plans, policies, and controls for the area concerned.

6.1.5.1 Fishing Grounds

Conflicts between aquaculture firms and commercial or recreational fishers could arise if the aquaculture site is a desirable fishing area or if the site attracts fish. Alston et al (2005) conducted a study as part of a demonstration project to assess the possible environmental effects involved in the culture of Lutjanus analis (mutton snapper) and Rachycentron canadum (cobia) in submerged open-ocean cages in Puerto Rico. "*A monthly visual census was made of the composition and relative abundance of fish aggregating at the cage site before the cages were installed and after fish were stocked and cultured. A high diversity and abundance of fish were found near the cages after stocking occurred. The pelagic and reef fishes around the pen may represent an expansion of the resources available to the fishermen and therefore a possible increase in fishing potential.* ***More research is needed to determine if the wild fish assemblage is benefiting directly or indirectly from additional nutrients from the aquaculture activity or if the cage structures naturally accumulate organisms and are simply serving as a substrate."*** Alston's research seems to indicate that fishers could benefit from the aquaculture activity, if they are able to access fish close to the pens. On the other hand, if the sites attract fish and fishers trying to harvest those species interfere with the aquaculture facility, conflicts could be exacerbated by the fish being attracted to the pens.

Commercial harvesters using trawl gear would need to maintain sufficient separation from the nets/pens when fishing. Entanglements between trawl gear and nets/pens could result in escapement from the facility and damage to both the fishing vessel's gear and the aquaculture facility. To minimize interactions, the nets/pens will be clearly marked.

It is important to ensure that traditional fishing grounds are considered by NOAA Fisheries Service during the siting process to ensure that conflicts are minimized. The Council's preferred alternative would not establish aquaculture zones, but would establish criteria for siting marine aquaculture facilities. Part of that siting criterion could be the consideration of historic fishing areas, in addition to the water depth and currents.

Not all interactions between the aquaculture industry and fishers are negative. The conflict resolution between recreational fishers and Texas marine aquaculture interests would have been easier if stakeholders entered the decision-making process earlier (Harvey and McKinney 2002). He concluded that if the process for determining usage of an area was viewed as fair, the participants are more willing to live with the outcome. To ensure that the process is viewed as fair all users of the resource must have a voice in the process.

Barnaby and Adams (2002) also found that commercial and recreational fishers could develop opportunities to work with offshore aquaculture businesses or start their own firm. Their knowledge of the ocean and access to vessels could prove to be of value to firms that need to

transport crew and inputs to and from the offshore facilities. Creating a symbiotic relationship could foster good will between the groups.

6.1.5.2 Navigation

Because the U.S. Coast Guard and the Army Corps of Engineers regulate navigable waters, aquaculture firms must comply with their regulations in addition to those implemented as part of this amendment package. The U.S. Coast Guard (14 U.S.C. 83 *et seq.*) requires that aquaculture structures located in navigable waters must be marked with lights and signals. The Coast Guard requirement is similar to this amendment's permit requirement that states "*As condition of permit the applicant must agree agree to maintain a minimum of one locating device on each pen or enclosure and immediately notify NOAA Fisheries Service in the event the pen or any retention aquaculture enclosure is lost at sea".* Pens could be marked with lights and markers as part of the locating devise required in this action. The lights and markers required should reduce unintentional conflicts with vessels navigating past the permitted aquaculture area. Persons intentionally interfering with a permitted aquaculture site could face fines or other penalties imposed by federal enforcement agencies.

The Rivers and Harbors Act (33 U.S.C. 403) requires a permit for activities in or affecting the navigable waters of the United States, including installations and other devices permanently or temporarily attached to the seabed, erected for the purpose of exploring for, developing or producing resources from the outer continental shelf (Section 10). Therefore, the aquaculture permit applicant will need to obtain a siting permit from the NOAA Fisheries Service and the Army Corps of Engineers. As discussed in Section 7, the permit applicant would be required to provide NOAA Fisheries Service with copies of state, ACOE and EPA permits and monitoring reports. The ACOE report will allow NOAA Fisheries Service to ensure that the permit holder has met the requirements of the Rivers and Harbors Act for siting a structure in navigable waters.

Implementing the requirements discussed above should minimize unintentional navigation conflicts. When conflicts result from intentional actions, those disputes would be settled through the enforcement/legal process.

6.1.6 Economic and Social Impacts on Domestic Fisheries

The economic and social impacts on domestic fisheries are discussed in detail in Section 5.3. That discussion is included here by reference.

6.1.7 Harvest of Prey Species for Feed

Baitfishes worldwide are under increasing fishing pressure due to expansion of the global aquaculture industry and demand from poultry and livestock farms. Because available fish meal and fish oils are not likely to increase, producers will need to find alternative sources of feed protein as the aquaculture industry continues to grow. In November 2007, NOAA Fisheries Service and the USDA began soliciting input and ideas from stakeholders on ways to lessen dependence on fish-based aquaculture feeds. Input will be accepted through February 29, 2008.

Worldwide approximately 25-30 million tons of fish are reduced to fish meal and fish oil annually (Tacon et al. 2006). This amount has generally been stable since the early 1970s (Tacon et al. 2006). Species from the Families Engraulidae (anchovies) and Clupeidae (includes menhaden) represent 89 percent of the fish destined for fish meal production worldwide (FAO 2005). The top species caught for production of fish meal globally include: Peruvian anchovy (6.2 million tons), blue whiting (2.38 million tons), Japanese anchovy (2.09 million tons), Atlantic herring (1.96 million tons), and chub mackerel (1.86 million tons). Gulf menhaden are 11th worldwide in total tonnage converted for purposes of fish meal. In 2003, 0.53 million tons were converted to fish meal and oils (Tacon et al. 2006). This accounted for 2.4 percent of the worldwide fish (in pounds) converted to fishmeal in 2003. Overall, the United States accounted for 5.6 percent of the worldwide fishmeal production in 2003 and 9.6 percent of the worldwide fish oil production in 2003 (Tacon et al. 2006).

Worldwide, the amount of fishmeal available for export from other countries has decreased in more recent years due to expanding aquaculture sectors and increasing domestic fishmeal demands, especially in countries such as Chile, Norway, Thailand, and Japan (FAO 2005; Tacon et al. 2006). Southeast Asia, Europe, Russia, and Canada currently account for a majority of the worldwide imports of both fishmeal and fishoil. The increased demand for fishmeal in China has been driven by the rapidly growing aquaculture and livestock sectors, relaxation of Chinese import duty/tax rates, and the reduced demand for fishmeal from Peru and Chile by European Union countries (Jystad 2001; Fang and Cao 2004). Worldwide, it is estimated that in 2003 the aquaculture sector used 20-25 million tons of fish for feed to produce 30 million tons of farmed finfish and crustaceans (Tacon et al. 2006).

Although fishmeal and fishoil production has been stable worldwide, there is growing concern that demand may outpace supply. A significant amount of research is currently underway to find dietary supplements for fishmeal and fish feeds, such as plant proteins and oils and animal byproducts (Tacon et al. 2006). Currently, aquaculture accounts for 46 percent of the worldwide use of fishmeal and 81 percent of the worldwide use of fish oil (Tacon et al. 2006). Predictions for future use vary, with some projecting increases in fishmeal and fish oil use for aquaculture feeds, while others predicting decreases. Regardless, the United States is well positioned to manage demand for aquaculture feeds.

In the United States, Gulf and Atlantic menhaden represent the greatest source of fish meal production, with Atlantic herrings and Californian pilchards accounted for a lesser amount of U.S. fishmeal and fish oil production. As discussed in Section 5.2.3.4, Gulf and Atlantic menhaden are not overfished and are not undergoing overfishing. Both species are managed by interstate compacts and assessments are conducted every four to five years by NOAA Fisheries

Service. If demand for these species increases due to development of an aquaculture industry in the Gulf of Mexico and increases in livestock feeds, then stock assessments will be used to assess the status of each of these populations. Necessary management adjustments could then be made on the basis of the assessments if fishing mortality is to high or stock biomass has dropped below threshold levels.

6.2 Action 1: Types of Aquaculture Permits Required

The Council is considering three alternatives for permitting aquaculture facilities. The first alternative is to maintain the current practice of issuing EFPs for aquaculture facilities. The second is to require a NOAA Fisheries Service permit to operate an offshore aquaculture facility. The third alternative requires both a siting permit as well as an operational permit.

U.S. per capita seafood consumption is comprised of a combination of domestic and imported product. Between 1990 and 2005, consumption of seafood has advanced from 15.0 pounds per capita (edible meat) to 16.2 pounds (edible meat) per capita (U.S. Department of Commerce, 2005). With population increasing during the same period from 248 million to 295 million, domestic distributors, over time, increasingly turned to imported product to satisfy domestic "wants" at an acceptable price. In 1990, for example, the U.S. supply of edible commercial fishery products totaled 12.7 billion pounds (round weight)[24]. Domestic production, equal to 7.0 billion pounds, represented approximately 55 percent of this total while imported product, equal to 5.6 billion pounds, represented the remainder. By 2005, the U.S. supply of edible commercial fishery products had advanced to 18.1 billion pounds (round weight)[25]. Domestic production, equal to 8.0 billion pounds, represented about 45 percent of this total while imported product, equal to 10.2 billion pounds, represented the remainder. Hence, while domestic production increased by approximately 1.0 billion pounds during the 15-year period ending in 2005, imported product increased by 4.6 billion pounds. Much of the increase in imported product represents aquaculture production; much of which is comprised of shrimp and salmon.

As per capita seafood consumption continues to increase in conjunction with an increasing population, domestic wholesale and retail suppliers are likely to increasingly turn to imported product to meet the country's demand for seafood at an acceptable price. This reflects two primary factors. First, many of the domestic capture fisheries are already fully utilized (if not overfished) and, hence, any significant increase in supply from domestic capture fisheries is unlikely. Second, global aquaculture has expanded rapidly (an average compounded rate of 8.8% since 1950)[26], which has allowed the placement of additional product on the world market.

Currently, the U.S. seafood trade deficit is about $8 billion and, in the absence of significant expansion of the domestic aquaculture program, currently valued at about $1 billion, is expected to increase. In recognition of the growing trade deficit, the U.S. Department of Commerce has "called for the development of a domestic [aquaculture] industry worth $5 billion by 2025

24 These figures ignore exports (1.9 billion pounds, edible weight) and supply derived from recreational activities (U.S. Dept. of Commerce, 1991).
25 These figures ignore exports (2.9 billion pounds, edible weight) and supply derived from recreational activities (U.S. Dept of Commerce, 2005).
26 Sustainable Marine Aquaculture Task Force report (2007)

(Marine Aquaculture Task Force, 2007)." Much of the emphasis is to be placed on increased production of marine species. This will require the development and implementation of a viable aquaculture policy related to the rearing of marine species in the EEZ. The policy should be crafted in a manner that ensures aquaculture facilities operate in an environmentally sound manner that does not pose threats to wild stocks or compromise Council objectives for managing wild fisheries.

6.2.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

Action 1 creates (or does not create) a permitting system for offshore aquaculture in the Gulf of Mexico EEZ. The permitting process is primarily administrative in nature and does not directly affect the physical, biological, or ecological environment. However, it could have indirect effects on the physical, biological, and ecological environment. Under **Alternative 1**, no change in the number of operational aquaculture facilities is expected; therefore, **Alternative 1** would have the least effect on this environment. **Alternative 1** does not require the development of any permitting system, but maintains the status quo of requiring an EFP for the operation of aquaculture facilities. EFPs authorize, for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited (50 CFR 600.745).

The requirement to procure an EFP before operating an aquaculture facility has proven to be an onerous task that is poorly suited for such an undertaking and has stifled the offshore aquaculture industry from developing. If an alternative permitting process is developed, as proposed in **Preferred Alternative 2** and **Alternative 3,** there will be an enhanced probability that the Gulf of Mexico offshore aquaculture industry would develop.

Preferred Alternative 2 would create a NOAA Fisheries Service permit to operate an offshore aquaculture facility. The development of an aquaculture industry is expected to have some indirect effects on the physical, biological, and ecological environments including issues discussed in Section 6.1. However, the implementation and use of a permitting process that has a multitude of conditions designed to monitor and/or negate negative effects on the physical, biological, and ecological environment would be the most prudent avenue to pursue, which is the intent of this amendment. The operational permit proposed under **Preferred Alternative 2** would have conditions, such as annual reporting and other recordkeeping requirements (see Actions 3 and 8), tied to the continued operation of a facility under that permit. If it was found that a facility was not operating under these conditions or failed to meet the recordkeeping and reporting requirements the permit could be revoked and operations suspended.

Alternative 3 would create a permitting system with a siting permit specifying the duration, size, and location of an offshore aquaculture facility and a second permit, an operating permit, specifying the marine species to be propagated, reared, or both, and design, construction, and operational details**.** The two-tier permit process involving the second permit for siting presents no additional safeguards to the physical, biological, and ecological environment. Action 6 is intended to minimize impacts of a facility on the physical, biological, and ecological environment by applying a number of criteria and conditions which dictate where a facility may

operate. This siting criteria action accomplishes what would otherwise be achieved by a dual permitting process as proposed under **Alternative 3**. Further, the ACOE will require a permit for siting aquaculture facilities in the EEZ under the authority of the Rivers and Harbors Act. Therefore, potential applicants would be subjected to redundant applications and permits if **Alternative 3** was chosen.

Both **Preferred Alternative 2** and **Alternative 3** would create a standardized means (permit(s)) for managers to use in evaluating an offshore aquaculture facility's design and operation, thereby its impact on the physical, biological, and ecological environment. The permit information required would include a number of conditions and information such as the type of system being used at the facility, which would allow for identification of potential impacts and an evaluation of those impacts (e.g. the impact mooring anchors employed by some systems would have on the benthic habitat). Similarly, the requirement to meet other conditions as specified in Action 3 and the recordkeeping and reporting requirements of Action 8 will allow managers to evaluate any impacts the facility may have or is having on the physical, biological, and ecological environment.

Alternative 1 would have the least effect on the physical, biological, and ecological environment. The lack of development in the offshore aquaculture industry is not expected to change under **Alternative 1**; however, the intent of this Amendment is to create a permitting process to foster the development of an aquaculture industry. Therefore, **Alternative 1** is the least preferred for the purposes of this Action. **Alternative 3** would create a dual permit process, which would create redundancy and unnecessary burden on potential applicants. This redundancy is both external and internal to NOAA Fisheries Service. Externally, the ACOE already has a siting permit requirement under their existing authority; internally, the conditions set forth in the siting criteria (Action 6) action will provide the necessary oversight for proper siting of facilities without the need for an additional permit. **Alternative 3**, by creating a permitting process, would have more of an affect on the physical, biological, and ecological environment than **Alternative 1**, but would accomplish the purpose and goals of this amendment.

Preferred Alternative 2 creates a single permit, which has a number of conditions and requirements (Actions 3, 4, 5, 6, and 8). In order for a facility to begin and continue operation all of these requirements must continuously be met. The conditions and requirements allow managers to efficiently examine the impacts of a facility on the physical, biological, and ecological environment in a standardized manner while still fostering the growth of an aquaculture industry in the EEZ. Additionally, **Preferred Alternative 2** does not place an undue burden on potential applicants by creating a redundant permitting process, but instead one, fully comprehensive permit. Though **Preferred Alternative 2** and **Alternative 3** have more of an effect on the physical, biological, and ecological environment than **Alternative 1**, they accomplish the purpose of this amendment in the best manner possible by creating a list of conditions to be met and maintained. Therefore, **Alternative 1** has the least impact on the physical, biological, and ecological environment, but **Preferred Alternative 2** and **Alternative 3** create a permit for aquaculture, which is the intent of this Amendment, and do so with the necessary tools for monitoring and maintaining the integrity of the physical, biological, and ecological environment.

6.2.2 Direct and Indirect Effects on the Economic and Social Environment

The status quo and two alternatives for issuing offshore aquaculture permits are considered in Action 1.

No new aquaculture permits would be issued under the status quo (**Alternative 1**). The status quo process, which allows the NOAA Fisheries Service RA to issue an EFP that is in effect for one year, would be required for offshore aquaculture firms. That permit may be renewed at the judgment of the RA, if a new application is submitted.

Federal permits would also be required that are not directly addressed or modified in this amendment[27]. The Rivers and Harbors Act of 1899 (33 U.S.C. 403) and the Outer Continental Shelf Lands Act (43 U.S.C. 1331-1356) provides the U.S. Army Corps of Engineers (ACOE) the authority to require permits for any structure that may obstruct navigation in U.S. waters[28]. The Clean Water Act (33 U.S.C. 1251 *et seq.*) and the Marine Protection, Research, and Sanctuaries Act (16 U.S.C. 1431 *et seq.*) provides the EPA with the authority to require point source pollution discharge permits, but the application to offshore aquaculture is somewhat ambiguous[29].

These permits, as well as other relevant permits, would, as noted, still be required under Action 1. Rather, this Action merely addresses the issue as to whether an Exempted Fishing Permit (i.e., the status quo) or an alternative permitting system be implemented for operating/siting of an aquaculture facility in the Gulf of Mexico EEZ. In general, the development of offshore aquaculture businesses are thought to be hampered by the current permitting process. Under the status quo (i.e., an EFP for conducting aquaculture would be required), the permit would be effective for no more than one year. While 50 CFR 600.745 does provide a provision for renewel of permits, this renewel is not automatic which adds a degree of uncertainty to any potential business venture. Therefore, all potential business ventures would need to account for the possibility that the EFP permit would not be renewed.

Given the status quo nature associated with **Alternative 1**, Net National Benefits, in terms of producer and consumer surplus, would be expected to be stable in the near term. In the longer-term, advances in aquaculture production techniques in other countries would likely result in the placement of additional product on the world market. Much of this additional product, furthermore, is likely to be comprised of same species or close substitutes to those harvested in the Gulf with the United States importing a relatively large share of the total. The increased

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27 Major Federal statutes affecting marine aquaculture are presented in Section 5.4.1 and are also examined in the Report of the Marine Aquaculture Task Force (2007).

28 According to the Marine Aquaculture Task Force report (2007), "[n]et pens or sea cages are potential hazards to navigation and hence fall under the purview of the U.S. Army Corps of Engineers (COE) in its responsibility to administer the River and Harbors Act of 1899. Under this act, the COE must conduct a public interest review and provide a permit under section 10 of the Act for hazards to navigation in U.S. waters (p. 26)."

29 A detailed discussion of the potential role of the EPA with respect to water quality can be found in Chapter 6 of the Report of the Marine Aquaculture Task Force (2007). As indicated in the report, "[u]nder the Clean Water Act, most net pen or sea cage aquaculture facilities require a permit to discharge pollutants into U.S. waters. Operations growing molluscan shellfish that do not add feed to the water are not required to obtain a permit (p. 24)."

supply of these species may reduce commercial ex-vessel prices and revenue[30], but would likely result in an increase in consumer surplus.

The commercial fishing industry will continue to support jobs and make purchases in fishing communities. These expenditures have traditionally occurred in the communities discussed in Section 5.3. The magnitude of these expenditures would not be expected to change as a direct result of this action. However, indirect impacts could result from changes in imports (wild or aquaculture) that may occur under any alternative. If imports do decrease revenues, it would decrease the amount of money the commercial fleet has to spend in these communities. Lower expenditures will negatively impact support industries in the fishing communities in terms of income and jobs. Because the aquaculture industry is not expected to develop, their potential expenditures will not offset the reductions from the commercial fleet.

Preferred Alternative 2 would create one new permit that would include both siting and operation of the facility. A**lternative 3** would create two permits. One would cover siting of the structures and the second would cover operating of the facility. In both cases the permit(s) would be issued under the authority of the Secretary of Commerce. The permit(s) would be required before a person could develop an aquaculture facility in the Gulf EEZ. The permit or permits (depending upon whether **Alternative 2** or **Alternative 3** is adopted) would allow its holder to operate outside Gulf of Mexico federal harvest restrictions that have been developed for the commercial and recreational fisheries. Without the permit(s), aquaculture firms would be required to abide by the regulations in place for each Council managed species or obtain an EFP.

The costs of obtaining a permit under **Preferred Alternative 2** or two permits under **Alternative 3** are not expected to differ by any significant amount. Specifically, since the same basic information associated with the siting procedure and operating the facility are required under both options and this information must be submitted to the respective Federal agencies (e.g., NOAA Fisheries Service and the Army Corps of Engineers) before obtaining the requisite permits for operating in the EEZ, one would anticipate comparable costs, .

The overall economic impact of issuing aquaculture permits for the Gulf EEZ could be substantial. For example, one aquaculture firm in Hawaii (Kona Blue Water Farms 2003) estimated that the optimum commercial farm size for a profitable offshore operation is approximately 790,000 lbs (360,000 kg) of mahi mahi and/or kahala per year. Assuming a price per pound for fresh product of $3.50 per lb, total revenue for the farm is around $2,770,000 per year. At least 6 net pens will be needed to produce this quantity of fish, which is the same size facility recommended by Posadas (2003) in the Gulf of Mexico. If the product markets will support their development, sufficient locations exist in the Gulf to support several firms of that size. Those firms would be capable of producing more of specific species than are harvested from wild Gulf of Mexico stocks.

Development of the industry may help offset anticipated future increases in imports. As noted, imports have increased significantly since the early 1990s and as discussed in Section 5.3,

30 This assumes negative own and cross-price flexibilities. Producer surplus would not decline if the commercial harvesters were not generating rents before imports increased. Charter operators and headboat operators would not be expected to generate producer surplus as a result of this action.

imports of many of the more important products harvested in the Gulf (e.g., snappers, groupers, shrimp) have increased significantly over time. As the technology to raise species that directly compete with wild Gulf of Mexico products (e.g., reef fish species, cobia) is fine-tuned, imports of those products, in the absence of an increase in domestic production (either wild harvest or offshore aquaculture) will increase. If the production of those species takes place outside the U.S., the economic activity associated with that production would not benefit communities close to the Gulf. Like under **Alternative 1**, commercial harvesters could realize reductions in ex-vessel prices and revenue. The difference in commercial ex-vessel price changes under the status quo and either of these alternatives cannot be predicted, but may be somewhat smaller under the status quo. If the U.S. production displaces an equal amount of those species that would have been imported, the overall increase in net benefits to the U.S. would be positive. Changes in consumer surplus would likely be the same, assuming product quality is similar in U.S. production and imported products. Producer surplus could increase if the aquaculture industry or industries that support aquaculture production generate economic rents.

Some coastal communities will benefit from the increased economic activity associated with the aquaculture industry. Each facility is expected to have startup costs of $4 to $5 million with annual operating expenses about $1.3 million (Posadas 2003). Labor costs were projected to be about 25 percent of the recurrent costs (Kona Blue Water Farms 2003). In that study the authors stated that

> *"The farming operations will most directly impact the local economy through employment, secondary support industries, and product availability. There will be direct employment of local people to staff the hatchery and grow-out operations, and increased employment for supportive industries. The farm will support other local businesses that will supply the wide variety of materials necessary to build and maintain the operations. In addition, fish supplied by the farm will stimulate economic activity in the restaurant trade, as well as the wholesale and retail fish trade."*

In general, the communities that are closest to the aquaculture sites are likely to receive the greatest benefits from a successful offshore aquaculture program. On a regional level, this activity may offset reductions in activity that results from reductions in commercial revenues that are expected to occur whether or not aquaculture production develops in the Gulf. There will be communities, however, that will likely be negatively impacted. Without a more complete understanding of where facilities are likely to be placed and the species that will be reared, however, it is impossible to state with any certainty which communities are likely to receive positive benefits from offshore aquaculture facilities and which communities will incur major costs (in terms of job displacement and/or reduced revenues from capture fishing activities)[31].

31 As suggested in the Sustainable Marine Aquaculture Task Force report (2007), "[a] large question looming as we begin to farm the sea is how will it transform coastal communities? Fitting into coastal communities will be a major challenge for the marine aquaculture industry as it expands into new areas and interacts with a variety of stakeholders. Coastal communities in many areas suitable for aquaculture have traditionally depended on fisheries and have, in recent decades, increasingly depended on tourism. The jobs and revenue that aquaculture brings have been welcomed in some coastal communities, including some hit hard by the decline of wild fisheries. Others, however, have rejected aquaculture development (p. 22)."

Producer surplus is roughly equivalent to profits[32]. If the imported product is a perfect substitute for the domestically produced product, producer surplus from the domestic captured fishery will, in theory, remain unchanged but total domestic producer surplus will be enhanced as a result of rent generation in the offshore aquaculture sector[33]. If the imported product is less than a perfect substitute for the domestic product (captured and offshore aquaculture produced), there is some potential for reduced producer surplus in the captured fishery sector. As noted though, due to a lack of even weak property rights in most of the Gulf managed fisheries, producer surplus is believed to be limited. The combination of the limited property rights and the reduction in imports emanating from offshore aquaculture provides justification for a conclusion that gains in producer surplus in the offshore aquaculture sector will exceed any losses in producer surplus from the domestic capture sector.

Consumers and producers make decisions based upon changes in the marketplace (e.g., output price) and changes in producer and/or consumer surplus are tied directly to these changes. Parties outside the market may also benefit from open ocean aquaculture[34]. For example, recreational fishing (e.g., average catch per trip) may be enhanced due to changes in the complex ecosystem web from offshore aquaculture activities that, say, increase the available fish feed and, hence, survival and growth of the wild stocks[35]. Given that this change in welfare occurs outside the market, it is considered an external benefit.

Alternative 3 requires an aquaculture operation to obtain two NOAA Fisheries Service permits before installing and operating a facility in the Gulf EEZ. The permit would be site specific, and if the permit holder wants to move the operation to a new location they would need to obtain a new permit. The Secretary would also be authorized to issue operating permits that regulate marine species to be propagated and/or reared and the design, construction, and operational details of the business. Operational permits could be linked to a specific site permit.

The economic impacts of selecting **Alternative 3** are similar to those of **Preferred Alternative 2**. Both have the potential to provide a structure that could create a new aquaculture industry in the Gulf. The feasibility of creating those businesses is still uncertain, based on the literature currently available.

6.2.3 Direct and Indirect Effects on the Administrative Environment

The creation of a permitting system will have a direct effect on the administrative environment, though the extent of that effect is difficult to determine due to the uncertainty in the number of

32 See Just et al. (2004) for a more detailed discussion of producer surplus, including alternative definitions.
33 Producer surplus can be enhanced in the aquaculture industry and also in related markets. For example, successful aquaculture may provide additional raw material for processing activities to established dealers (assuming processing is not undertaken directly by the aquaculture facility). This, in theory, could enhance profitability in the existing processing sector, assuming raw material is a current binding constraint. Keithly and Martin (1997) indicate that excess capacity in the reeffish processing industry is large. Under this scenario, producer surplus in the processing sector is likely to increase if there is a constant markup which covers all expenses (including normal returns on investment).
34 There may also be costs to parties outside the market. These costs are considered momentarily.
35 One should realize that this is merely a hypothetical example. It is also conceivable that antibiotics or components of fish feed could negatively impact recreational (or commercial) fishing activities.

applicants expected to apply for a permit. Despite this, a permit is almost completely administrative in nature and therefore is expected to have a direct effect on the administrative environment.

The status quo as applied under **Alternative 1** currently has a negative effect on the administrative environment. The full requirements and process for application and issuance of an EFP can be found in 50 CFR 600.745 and are summarized here. The RA must review all information pertinent to the EFP and, where necessary, request further information if clarification is needed. NOAA Fisheries Service must then publish the EFP in the *Federal Register* and solicit public comment on the proposal for 15-45 days. Finally, after the public comment period, the Council reviews the EFP, comments, and then NOAA Fisheries Service approves or disapproves the EFP. In addition to NOAA Fisheries Service and the Council's administrative environment being negatively affected, other regulatory agencies, depending on the nature of the EFP and their regulatory authority, may also have to comment or request additional information. This negatively affects these agencies' administrative environments.

The intent of creating a permitting process through this amendment, whether one permit (**Preferred Alternative 2**) or two (**Alternative 3**), is to eliminate some of the burden placed on the administrative environment of NOAA Fisheries Service and various agencies' administrative environments. A standardized permit, as created by **Preferred Alternative 2** and **Alternative 3**, would afford agencies a more streamlined review of the aquaculture facility's operations and impacts without sacrificing the integrity of their review.

The permit will be designed to incorporate the requirements of the other agencies using their regulatory authority (e.g. Action 6, siting criteria, which incorporates the criteria of other agencies), thereby eliminating the need for additional information requests. Potentially, this could eliminate the need for other agencies' need to review individual permits. Memoranda of Understanding (MOU) or General Permits could be issued by these agencies which provide authority to NOAA Fisheries Service in issuing aquaculture permits, provided conditions are met as specified in the MOU or General Permit. Considering the potential reduction on the administrative environment that could be expected form the permit process, both **Preferred Alternative 2** and **Alternative 3** are more beneficial than **Alternative 1**. Further, **Preferred Alternative 2** is more beneficial than **Alternative 3** to the administrative environment because it involves only one permit, thereby reducing the burden placed on the administrative environment even more.

For the same reasons as described above, **Preferred Alternative 2** and **Alternative 3** would have more beneficial indirect effects on the administrative environment than **Alternative 1**. By reducing the burden on the administrative environment in the application process and review, administrative resources could be allocated in areas of higher concern for both NOAA Fisheries Service and other agencies.

6.3 Action 2: Duration of the Permit

Action 2 includes two alternatives. **Alternative 1**, no action, would continue to allow an EFP to be effective for one year. **Preferred Alternative 2** would require an aquaculture permit to have an effective period of 5, 10, or 20 years, or indefinitely.

6.3.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

The alternatives under consideration differ only in the length of the aquaculture permit effective period. Depending on the alternatives chosen for other actions in this amendment, records kept by the aquaculture facility owners may be reviewed by regulators well before a permit is up for renewal. However, renewal of the permit could entail a more thorough analysis of owner compliance with permit requirements and of whether the environmental effects of the facility are acceptable. If a facility is causing unacceptable physical, biological, or ecological effects (as defined and described elsewhere in this document), longer permit durations could lead to greater detrimental physical, biological, and ecological consequences than shorter ones because these unacceptable effects would persist over a longer time before remediation. Therefore, if a facility had negative effects, **Alternative 1** would have the least negative physical, biological, and ecological consequences since it has the shortest permit duration, while **Alternative 2d** would potentially have the most negative consequences because it allows the longest permit duration (indefinite). The remaining alternatives, in decreasing order of permit duration and potential for negative environmental effects, are **Alternative 2c**, **Preferred Alternative 2b**, and **Alternative 2a**.

However, with the recordkeeping and reporting requirements established in Action 8 and the conditions attached to the permit (Action 3), it is not expected that a facility will be able to operate for any extended period of time while engaging in detrimental activities to the physical, biological, and ecological environment. NOAA Fisheries Service is expected to have Regional Aquaculture Coordinators who will conduct on-site inspections on at least an annual basis, if not more frequent, to monitor compliance with the conditions and requirements specified in other actions of this amendment. Therefore, the permit duration most likely will have no effect at all on the physical, biological, and ecological environment, whether directly or indirectly.

6.3.2 Direct and Indirect Effects on the Economic and Social Environment

Some offshore aquaculture will be capital intensive with significant costs likely occurring years prior to the generation of any stream of revenues. Start-up costs are likely to be $4 to $5 million for mid-size operations. Smaller operations owned by a current fishing boat operator may be substantially less. Investments by large vertically integrated corporations may be much larger ($10 million or more). Start-up costs for any scale of operation may require investments from outside the firm's ownership. Investment will only occur if the permit holder has some certainty that he will be able to recoup all upfront costs (i.e., sunk costs) and, over time, realize a positive return on his investment.

The amount of time needed to generate a revenue stream and, ultimately, realize a positive return on investment will likely vary by species. For faster growing species, a stream of revenues may be forthcoming within a matter of a couple of years. For slower growing species, revenues may not be realized for several additional years. Any system that limits the effectiveness of a permit to a duration less than that needed to realize a profit associated with the growing of some species (and a profit equal to or exceeding other investment opportunities) may limit the species that would otherwise be grown. Permit duration will also inhibit investment in new technology if the

time frame is too short. Hence, permits of a limited duration are likely to have the perverse effect of discouraging entrepreneurs from investing in new technologies that would reduce the cost of production.

The optimal permit duration, however, depends upon the Council's objective(s) associated with this Amendment. The primary purpose of this Amendment is "… to develop a regional permitting process for regulating and promoting environmentally sound and economically sustainable aquaculture in the EEZ (p.4)." According to the National Offshore Aquaculture Act, specifically, it is the policy of the United States to "[e]stablish a permitting process for offshore aquaculture in the Exclusive Economic Zone to encourage private investment in aquaculture operations…" From this viewpoint, the issue of comparing between alternatives is simply one examining how the different alternatives encourage (discourage) private investment. However, actions that could be taken to encourage private investment in aquaculture operations may, in some instances, detract from net benefits. These issues are addressed with respect to each of the alternatives.

Under the no action or status quo alternative (**Alternative 1**), the permit will expire after one year, unless an application is resubmitted and approved by the RA. Given the uncertainty of renewal of the permit under this alternative, entrepreneurs are unlikely to invest and lending institutions are unlikely to finance offshore operations[36]. It is thus clear that this alternative will not achieve the stated purpose of the Amendment (as modified based on The National Offshore Aquaculture Act of 2007)[37]. Given that this is the status quo situation, however, Net National Benefits, as measured by combined producer, consumer, and third party surplus, are expected to remain unchanged if this alternative is selected. As discussed below, however, unless there are substantial external costs associated with offshore aquaculture operations (i.e., opportunity costs associated with displacement of other activities, risk, etc.) for which society is not being compensated, higher Net National Benefits could be achieved with longer tenure[38].

What are the opportunity costs of displaced alternatives? As mentioned, the potential alternatives vary, ranging from commercial and recreational fishing to mineral extraction[39]. Yet, the Gulf of Mexico is large, encompassing some 3.9 million square kilometers[40]. The largest industry indirectly supported by the Gulf ecosystem (in terms of space used for (semi)permanent infrastructure is the oil-and-gas industry, Currently, there are approximately 4,200 active leases in water depths in excess of 1,000 feet and of this total, 750 are in water depths of 7,500 feet or

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36 Certainly, the lack of security of tenure associated with having to submit for a new permit each and every year adds uncertainty to any quasi-property right regime. Given the high upfront costs and the relatively long period of time needed to realize a profit, one might expect that only those with a risk taking utility function would apply for permits under this management regime. One might also argue that the paucity of requests for EFP permits for the purposes of offshore aquaculture might reflect prevailing uncertainty regarding whether the permits will be renewed. Finally, the fact that NOAA is proposing a regulatory framework to help establish a offshore aquaculture industry (most permits would be for twenty years with renewal of up to twenty years) provides a rather convincing argument that NOAA is under the impression that the EFP process is unsuitable.

37 One qualification to this conclusion is warranted. If longer-term permits are routinely provided (e.g., ten years), then Alternative 1 is equivalent to Alternative 2.

38 This finding, of course, is premised on the hypothesis that offshore aquaculture would be profitable under the appropriate institutional and regulatory framework.

39 Bunsick (2003) provides a more detailed listing of potential other uses.

40 An unknown, but perhaps large, percentage of this total is not in the U.S. EEZ.

more (Richardson et al., 2004). These structures, as reported in Section 6.1 occupy but a small fraction of the Gulf of Mexico (0.00025 percent)[41] and conflicts between competing interests are apparently manageable[42].

It seems reasonable to assume that the number of offshore aquaculture facilities, even if highly profitable, is not likely to approach that of oil-and-gas structures and that the size of the aquaculture facilities are likely to be less than many of the larger oil-and-gas structures[43]. Hence, one is left with the conclusion that opportunity costs to society from offshore aquaculture facilities may be relatively small and can be reduced based on adoption of other actions in this Amendment[44]. This conclusion, however, is highly speculative given all the uncertainties associated with this yet-to-be developed industry[45].

Under **Alternative 2**, the range of options varies from 5 years to 20 years with one additional option of an indefinite period[46]. Five years (i.e., **Alternative 2(a)**) of investment for some species is likely to be too short to realize a positive return on investment associated with the production of slower growing species and could limit their production. The entrepreneur must weigh the expected return from offshore aquaculture investment with the expected return from alternative investment opportunities. If other opportunities for investment offer a higher rate of return, the entrepreneur would invest in those opportunities. While a 5-year timeframe may be sufficient to realize a positive return on investment, the return may be relatively low due to the high upfront (i.e., sunk) costs that would need to be recovered within a relatively short period. Given this to be the case, higher returns are likely to be achieved elsewhere. Unless external costs and/or administrative costs are high relative to the benefits, one can conclude that a longer duration under **Alternatives 2(b-d)** will provide higher net benefits to society (assuming that long-run profitability would be forthcoming).

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41 If only the northern Gulf were to be considered, however, the percentage would be significantly higher.

42 In fact, the larger concern appears to be associated with the removal of oil-and-gas structures and the impact that removal has on recreational (and possibly commercial) fishing activities. This concern led to the development of the Louisiana Artificial Reef Plan whereby obsolete oil-and-gas structures could be sunk in designated sites.

43 Some of the offshore aquaculture facilities may, in fact, be converted oil-and-gas platforms. A detailed discussion of the potential uses of obsolete oil-and-gas platforms in offshore aquaculture production can be found in Kolian and Sammarco (2005).

44 Valderrama and Anderson (2006) report that "…the siting of an experimental aquaculture growout facility for sea scallops off the coast of Martha's Vineyard, MA, found strong opposition from local commercial fishermen who argued that the proposed location would hamper lobster fishery activities (p. 23)." Details can be found in Westport Scalloping Corporation (1998). Opposition in the Gulf may also be strong. As discussed in Federal Register: December 23, 2003 (Volume 68, Number 246)], "Florida Offshore Aquaculture, Inc., requested an EFP to determine the feasibility of raising fish in the exclusive economic zone approximately 33 miles (53 km) WSW. of Johns Pass, FL." The Federal Register further states that "[d]uring the public comment period, 340 individuals opposed the granting of the EFP. In
addition, one shrimp firm opposed the EFP because it would disrupt their operations. "To some extent, the wide opposition may reflect the proposed siting location. Siting locations in the Northern Gulf, where juxtaposition of oil activities and other Gulf-based activities are more established, opposition may have been less.

45 As section 2.2 of this Amendment suggests, "...up to 50 future aquaculture operations in the Gulf of Mexico over the next five years" may be considered a reasonable number.

46 For purposes of comparing the different permit durations it is implicitly being assumed that the permits are not renewable.

At this stage of the planning process, it is difficult to identify, much less quantify, external costs. These costs will depend on a large number of factors, including the number of facilities that come into operation over time; potentially related to the outcome of this amendment. Furthermore, external costs are likely to depend upon the options selected throughout this amendment. For example, designating sites for aquaculture facilities may reduce external costs if there are areas in the Gulf that are highly valued for other uses. Similarly, limiting the species that can be raised may, as indicated later (Action 4) reduce external costs[47]. As previously indicated, however, many of the external costs appear to be somewhat limited, given oil-and-gas structures as a basis for comparison.

Under **Preferred Alternative 2(b)**, the duration of the permit would be for 10 years. This option, along with 5-year renewal increments, was proposed in The National Offshore Aquaculture Act of 2005[48] that was not made into law. However, a revised version of the national legislation, introduced in 2007 as HR2010, proposes 20-year durations with renewals in increments up to 20 years. **Alternative 2(c)** is similar to **Preferred Alternative 2(b)** with the difference being that the duration would be for 20 years. Based upon the options proposed by the Council, it is implicitly assumed that renewals and/or transfers will not be permitted.

Increasing the duration of the permit will allow for sunk costs to be spread out over a longer time period implying lower fixed costs per year of operation. Hence, the return on investment over the duration of the permit will be enhanced.

Whether Net National Benefits are higher under **Preferred Alternative 2(b)** or **Alternative 2(c)** depends upon several factors. Assuming offshore operations are profitable (i.e., encouraging investment), producer surplus will be higher under **Alternative 2(c)** than under **Preferred Alternative 2(b).** Similarly, one can assume that consumer surplus under a 20-year duration exceeds that of a 10-year duration. Hence, excluding external and administrative costs, the conclusion can be made that higher net benefits will be forthcoming under **Alternative 2(c)** than **Preferred Alternative 2(b).**

Under **Alternative 2(d)**, duration of the permit would be 'indefinite.' If permit applicants consider this term to infer a (semi)permanent permit, it would begin to mimic the dimensions of pure property rights, though the rights would be relatively weak in nature[49]. As inferred property rights are strengthened with duration, expected investment will be enhanced. This represents not only upfront investment, but also long-term investment. With any limited duration permit, at

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47 As discussed later, the issue of whether the facility is removed when the operation terminates must also be figured into any estimation of external costs.

48 This is also the recommendation of Cicin-Sain et al (2005). According to the authors "[a] lease of ten years, renewable every five years, would, in our views, provide an appropriate balance." The authors, however, provide little rationale for this conclusion.

49 For example, strong property rights would allow transfer of property by act of sale or donation from one owner to another. As noted by Hoagland et al. (2003) "[i]n general, the more weak are the rights, in terms of shortness of tenure, geographic limits, difficulty of transfer to other parties, potential of revocation, work or performance requirements… the more risky it becomes for the aquaculture entrepreneur. The reason for increased risk is that such restrictions decrease the flexibility of the entrepreneur to respond to the inevitable, but difficult to forsee, environmental and market considerations. Costs associated with these risks will reduce the size of the resource rent, making it less likely that the access system can be characterized as efficient (p. 35)."

some point entrepreneurs will begin to draw down fixed capital (i.e., depreciation) rather than reinvesting in capital. This option would likely provide the greatest Net National Benefits.

Overall, the preceding discussion would tend to suggest that unless external costs are high relative to benefits, economic efficiency would increase as the permit duration is increased. If external costs are high relative to benefits, however, one would likely conclude that any permit duration that is of a sufficient length to encourage investment would result in a decrease in Net National Benefits. While it is difficult to even qualitatively assess all external costs much less quantify them, the conclusion was reached in this section that they may be relatively limited, though this conclusion is reached with a number of caveats. If correct, however, the implication would be that economic efficiency would be enhanced with extension of the permit duration.

While the analysis to this juncture tends to argue for a more extended permit duration, that conclusion is reached on what can best be described as a "static" evaluation of external costs. Specifically, current external costs are believed to be relatively minor and the assumption is implicitly made that they will remain minor in the future. While it may be belaboring on the obvious, it is impossible to predict what the demand for ocean space will be in the distant future. A long permit tenure system may tend to "lock in" system which, if found to be lacking, would be difficult to revoke.

Finally, one must consider the Public Trust Doctrine. As noted by Cicin-Sain et al. (2005), while the "[a]pplication of the public trust doctrine does not preclude the government from granting the right to use public resources to a private individual or entity …[i]t does, however, obligate the government to manage these public resources for the greatest benefit of all (p. 44)." Given the long-term uncertainties discussed throughout this option, one possible tradeoff between encouraging investment and the application of the public trust doctrine may be to provide a limited duration with a provision for renewal[50]. The Offshore Aquaculture Act of 2007 (Appendix B) has such a provision[51].

6.3.3 Direct and Indirect Effects on the Administrative Environment

Permit renewal is administrative in nature and would affect this environment directly. The intensity of that effect, however, varies with frequency of review and renewal. The administrative burden of reviewing applications for permit renewal decreases as the length of time between renewals increases. The administrative environment would be least affected with an indefinite period (**Alternative 2(d)**), and most affected by the continued use of EFPs. Given the lack of recent applications through the EFP process, it may be better to state **Alternative 2(b)** would impose the greatest burden to the administrative environment. The remaining alternatives, in decreasing order of permit duration and increasing potential for negative administrative effects are **Alternative 2(c)**, **Preferred Alternative 2(b)**, and **Alternative 2(a)**.

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50 Language would need to be given that, in the absence of negative findings or significant changes in demand for ocean space, renewal is anticipated.

51 An earlier version of this bill was introduced by Senators Stevens and Inouye but did not make it out of committee. The more recent 2007 National Offshore Aquaculture Act, which was transmitted to Congress on March 12 and introduced as HR2010, also stipulates a limited duration with a provision for renewal, but increases the duration from 10 years to 20 years in response to stakeholder feedback on the earlier version.

As stated previously, the development of an aquaculture industry is going to directly affect the administrative environment. Most of this burden comes from the inspection of facilities and checking for compliance with requirements and conditions of the permit, not from the renewal of permits which may be an unnecessary burden given the level of engagement from the administrative environment. At the same time, renewals should be fairly straight forward and easily accomplished due to the wealth of information that will already exist on a facility because of the reporting, recordkeeping, and inspections. Therefore, renewal periods may not directly effect the administrative environment much more than it will already be affected by carrying out the necessary responsibilities from the creation of a permit process. Therefore, any of the suboptions under **Preferred Alternative 2** would have less impact on the administrative environment than **Alternative 1**, because of the other actions that are part of creating a permit process (i.e., the information for determining to renew or not renew a permit will already exist from recordkeeping, reporting, and inspections), compared to the renewal steps necessary for an EFP.

6.4 Action 3: Permit Conditions

The Council is considering three alternatives when considering conditions applied to permitting aquaculture facilities. The first alternative is to not specify any conditions when issuing a permit to an aquaculture facility. The second alternative is to require a facility to meet the conditions set forth in an EFP. The third alternative would require each aquaculture operation to adhere to a number of conditions for initial issuance of a permit and then for continued operation of the facility under the permit. These conditions are designed to provide as much information as possible to NOAA Fisheries Service for decision making purposes.

The conditions (as listed in Section 4, Action 3) are designed to: 1) limit the impacts, both genetically and otherwise, on wild Gulf stocks, 2) monitor the health of animals in an aquaculture facility, 3) provide safeguards to the environment, 4) improve law enforcement capabilities, and 5) provide NOAA Fisheries Service with other details of facility operation.

6.4.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

Requiring conditions to be met prior to issuing a permit and monitoring the compliance with those conditions is an administrative function and has no direct effect on the physical, biological, or ecological environment. However, the majority of these permit conditions are designed to limit the impact on wild populations and the environment and will therefore have an indirect effect on the physical, biological, and ecological environment.

Alternative 1, the no action alternative, would allow aquaculture facilities to be issued permits with no conditions of operation for the facility. This could negatively affect the physical, biological, and ecological environment. Without conditions applied to, or oversight of, issues such as source of broodstock or fingerlings, aquatic health management protocols, or environmental monitoring, facilities would be subject to the guidelines provided by the EPA, ACOE, and MSFCMA. This approach to implementing aquaculture in the EEZ has been viewed as a poor methodology which is cumbersome and burdensome to any company trying to develop

an operation. Thus, the Council is attempting to modify this process by altering their FMPs through this Amendment/EIS to allow aquaculture in the EEZ, while also attempting to engage other regulatory agencies in developing a permitting process. The conditions developed under this action are an attempt to address many of the concerns and requirements of these other regulatory agencies and thus, create a better system for implementing aquaculture in the EEZ.

Alternative 2 would require an aquaculture facility applying for a permit to meet the conditions specified through the issuance of an EFP (See Appendix A). Though this would allow the Regional Administrator to specify the conditions of the EFP, it could cause inconsistencies from one facility to the next and places a substantial burden on the administrative environment. **Alternative 2** would also require review by other regulatory agencies and provide no standardized means for the facility to describe its management practices. As described in **Action 1**, EFPs involve a very cumbersome process and do not provide the best means for issuing long-term aquaculture permits, as they are not designed for such an endeavor.

Preferred Alternative 3 provides a detailed list with a number of conditions designed to eliminate or mitigate the impacts of aquaculture facilities on the physical, biological, and ecological environment. The first condition under **Preferred Alternative** 3 would require all facilities to have an assurance bond. This assurance bond would be used for removal of all aquaculture facility equipment upon termination of an operation. The intent of this condition is to avoid a company abandoning the structure/equipment and that equipment being left at-sea, which may lead to environmental damage or become a navigational hazard. Similar to this condition is the condition requiring an emergency disaster plan for hurricanes, net or cage failure and subsequent escapement, or a pollution event. As a sound business practice with millions of dollars invested, most of these contingency plans will most likely be in place voluntarily. The loss of fish, equipment, and pollution to the environment all result in or could potentially result in the loss of profit to an aquaculture facility. The plan, however, will help NOAA Fisheries Service (or other agencies) to assess the adequacy of the plan and aid in strengthening that plan if it is deemed necessary to do so; additionally, an agreed upon plan may allow agencies to assist during a disaster to help ensure the event is recovered from with the least amount of impact to the environment.

The next set of conditions is designed to limit the impacts aquaculture has on the genetics of wild populations. This issue is more fully discussed in Section 6.1.1 and is included here by reference. The concerns about genetic diversity and the potential impacts aquaculture could have on wild populations lead to a number of conditions that limit the source of fish used in aquaculture, as well as requirements to maintain records proving source, turnover, and condition of broodstock and or fingerlings used in operations. Another set of conditions under **Preferred Alternative 3** involves the development and implementation of an aquatic animal health plan. Section 6.1.2 has a thorough discussion of aquatic animal health and is incorporated here by reference. An aquatic animal health plan is designed to monitor the health of organisms grown in the facility and to limit the impact any disease outbreak may have on adjacent wild populations. Section 6.1.2 also discusses the treatment and control of disease organisms and the impacts that may occur to wild populations.

The conditions set forth in **Preferred Alternative 3** also require an environmental monitoring plan. The intent of this condition is to limit interactions with threatened or endangered animals

(see Section 6.1.4 for a detailed discussion), ensure facilities have an environmental monitoring plan, and that EPA standards are adhered to. A number of the issues surrounding the need for this requirement are discussed in Section 6.1.3, which highlights the importance of facilities to maintain good water quality. The facilities should be able to maintain the intent of this condition by maintaining EPA standards. Likewise facilities must report encounters with MMPA and ESA species. Section 5.2.3.3 provides a list of species currently considered by the MMPA and ESA for the Gulf and the potential actions to determine the impact of aquaculture on these species. Another set of conditions in Action 3 that facilities must adhere to is designed to aid law enforcement in their monitoring of aquaculture operations. Creating an aquaculture permit opens a loophole through which unscrupulous individuals may try to move poached product. Aquaculture will increase the pounds available on the open market, making identification of origin an even more important aspect of law enforcement. By requiring facilities to notify law enforcement of harvest activities and carrying an aquaculture permit, identification at time of landing will be made easier. The use of fin clips will allow law enforcement officials to identify the origin individual fish in the market place by genetic comparison to the broodstock used by aquaculture operations. If the product is labeled as aquaculture and it is not tied to a genetically identified broodstock used by a facility, the enforcement agent will be able to determine that the fish was in fact a wild caught specimen, and therefore subject to the management regime for that species.

Preferred Alternative 3 also includes a use it or lose it provision. The intent of this provision is to eliminate speculative entry by permittees who have no intent of developing an aquaculture industry and instead are trying to charge rent on the most suitable aquaculture sites. When considering offshore aquaculture, Knapp (2006) concluded that fewer direct conflicts with other users would be realized relative to nearshore aquaculture. However, this may not hold true if speculative entry were allowed any large areas were procured for aquaculture that were never used for that purpose (see Section 6.1.5 for further discussion of user conflicts).

The final conditions set forth in **Preferred Alternative 3** are other requirements that will help with monitoring and law enforcement. Basic information about vessels and enclosures used by aquaculture operations, as well as requirements intended to help distinguish those vessels from commercial fishing vessels, will decrease the chance for illegal fishing to occur under the guise of aquaculture operations. Alternative 3(f) would provide NOAA Fisheries Service with additional flexibility to specify permit conditions for administration and issuance of a permit. Although it is unknown what additional permit conditions may be specified by NOAA Fisheries Service, the most likely scenario would be specification of additional requirements intended to ensure environmental impacts are prevented or mitigated to the extent practicable.

6.4.2 Direct and Indirect Effects on the Economic and Social Environment

NOAA Fisheries Service is considering requiring specific conditions be met in order to qualify for a permit. The conditions fall into two categories: (a) an assurance bond to guarantee removal of structures when the permit expires and (b) information potential permit holders would need to provide to NOAA Fisheries Service prior to receiving a permit.

The impacts associated with Action 3 **(Alternative 1)** are closely tied option selected under Action 1. If Action 1 **(Alternative 1)** is selected, then **Alternative 1** and **Alternative 2** are

equivalent in Action 3. This is because Action 1, **Alternative 1** would require an Exempted Fishing Permit for conducting offshore aquaculture operations. Hence, while Action 3**,** **Alternative 1** does not directly specify permit conditions, they are specified in the EFP process.

However, if either **Alternative 2** (require a NOAA Fisheries Service permit to operate a marine aquaculture facility in the Gulf EEZ) or **Preferred Alternative 3** (require separate siting and operating permits for an aquaculture facility in the Gulf of Mexico EEZ) associated with Action 1 is selected, then **Alternative 1** can require more or less information than that which would be required under **Alternative 2** or **Preferred Alternative 3**.

For purposes of analysis, it is assumed that requested information will be a minimum when not required by other regulations (e.g., name, telephone number)[52]. With this limited amount of information, NOAA Fisheries Service will be unable to assess the potential impacts of the proposed facility on the surrounding environment. Furthermore, there would be no assurance that the facility has the appropriate measures in place if a problem were to arise (e.g., disease outbreak). Third, the lack of information will hinder enforcement activities that might be necessary to ensure the safety of the numerous parties dependent upon the Gulf's resources (and society at large). Enforcement of these facilities is paramount and any action that would detract from enforcement capabilities could potentially represent a large cost to society. Finally, the information collected under this Alternative will be insufficient for the members of the public to reach rational conclusions regarding whether or not they wish to support the permitting of specific facilities.

In general, one can conclude that the costs to potential offshore aquaculture business ventures under the status quo (**Alternative 1**) will be a minimum. Administrative costs will also be minimal. While private and administrative costs will be a minimum, costs to society are potentially large.

Information requirements under this Alternative, as indicated are considerably more (and more explicitly stated) than the assumed information requirements under Alternative 1. Since 50 CFR 600.745(b) (3) (v) allows the Regional Administrator or the Director "[r]easonable data reporting requirements" (subparagraph F), however, NOAA Fisheries Service still has considerable latitude regarding what information it can request from the applicants. To protect the marine environment and to facilitate enforcement, one would expect that "reasonable data requirements" requested by the Regional Administrator or his designee would closely "mirror" those stated in **Preferred Alternative 3(b)** of this Action[53]. Hence, with some minor distinctions (discussed in Association with Alternative 3.b, one would expect little differences in the discussion of benefits and costs associated with **Alternative 2** and **Preferred Alternative 3(b)**.

Preferred Alternative 3(a) would require an assurance bond as a condition of permit issuance. Two issues need to be considered here: 1) the impacts of this requirement on economic efficiency (net national benefits) and 2) the impacts on investment. It is first useful to address the question whether removal enhances net national benefits. There are costs associated with

52 This assumption was made based on pers. comm. with Dr. Stephen Holiman, NMFS.
53 As discussed below, all information requirements associated with Alternative 3.b appear "reasonable."

removal. For oil-and-gas platforms, these costs can be significant. A study of using these platforms for marine aquaculture stated that removal bonds for major structures in Federal waters start at $100,000 per year and can cost as much as $4 million per year (LUMCON 2005). These costs need to be compared to the benefits of removal. The benefits represent the reduction in external costs to society that are likely to continue after the aquaculture operation terminates. One of the larger benefits may relate to safety considerations of vessels shrimping or traversing through the area. The costs of the assurance bonds will reflect the overall expense of removing the aquaculture structure. If the structure is large or difficult to remove, the assurance bond will be more costly. The lower the cost to remove the structure the less the assurance bond should cost. Higher fixed costs will reduce long-run profitability.

If there is a clear desire for operations to remove structures upon termination, the use of assurance bonds may be a cost-effective means of accomplishing this goal. In the absence of an assurance bond, it may be difficult to recover the money for removal if the company enters bankruptcy or if the company simply chooses not to remove the structures. Litigation would then be required which can be both expensive and lengthy. Obligation of an assurance bond may be less costly, therefore, than litigation.

Preferred Alternative 3(b)[54] would require those investors seeking an offshore aquaculture permit to provide NOAA Fisheries Service with a set of plans for addressing or monitoring certain environmental conditions so that adverse conditions can be prevented. All items listed in **Preferred Alternative 3** should have been considered and included in any "good" business plan. Hence, the cost of providing this information to NOAA Fisheries Service should simply be some administrative costs associated with processing the relevant information. These administrative costs should be nominal relative to start-up costs or annual operating costs.

The benefits to society of NOAA Fisheries Service having this information are large. First, it will allow NOAA Fisheries Service to more fully assess the potential impacts of the proposed facility on the surrounding environment. Second, it will help to ensure that the facility has the appropriate measures in place should any problems arise. Third, it will facilitate enforcement associated with the proposed activities. Finally, assuming the information provided to NOAA Fisheries Service is not proprietary in nature, members of the public will be able to obtain valuable information from which will allow them to make more informed judgments regarding internal benefits and costs of the proposed facility.

In general, one can conclude that the benefits associated with adopting **Preferred Alternative 3(b)** exceed the costs by a significant margin. The benefits associated with **Preferred Alternative 3(b)** far exceed those of the status quo (**Alternative 1**) under the assumption that data requirements under the status quo would be minimal. While one could anticipate that information requirements specified in **Alternative 2** would mirror those in **Preferred Alternative 3(b)**; the later alternative has the benefit that the information request is explicitly stated. Thus, potential investors will know what information will be required as they are

54 Note that if Action 1, Alternative 2 is selected as the preferred alternative, then the information requested under Action 3, Alternative 3.b may be incompatible with the preferred Alternative selected under Action 1. Since the phrase "reasonable data requirement" is included in 50 CFR 600.745(b) (3) (v), however, one cannot necessarily conclude that they are incompatible.

developing their business perspectives. Since costs under any of the scenarios will be minor, one can conclude that Net National Benefits of **Preferred Alternative 3(b)** are significantly greater than those of the status quo and are likely to be marginally higher than those associated with **Alternative 2**.

The intent of the elements in **Preferred Alternative 3(c)** is to improve law enforcement's ability to monitor offshore aquaculture production. All of the options in **Preferred Alternative 3(c)** will increase the costs to the firm complying with the requirement. **Preferred Alternative 3(c)(1)** through **Preferred Alternative 3(c)(3)** will likely reduce the cost of enforcing the program. **Preferred Alternative 3(c)(4)** will increase costs to both NOAA Fisheries Service and the firm, but should improve the governments ability to ensure only that firms stock is being harvested.

Preferred Alternative 3(c)(1) would require any vessel used in the aquaculture operation to have an aquaculture permit on board the vessel. Requiring the permit to be onboard allows enforcement personal to identify the firms that are associated with the harvest or supplies onboard the vessel. The cost of having the permit on board will include the time required to obtain a copy of the permit and the cost of displaying the permit. Both of these costs should be less than $25 unless NOAA Fisheries Service charges a fee that cause that price to be exceeded..

Preferred Alternative 3(c)(2) would require that the aquaculture firm notify law enforcement of the time, date, and port of landing at least 3 hours prior to landing. The advance provides enforcement staff with a warning that a landing is eminent and allows staff to observe and take samples of offloads. Limiting the required notice time to 3 hours should provide aquaculture operators sufficient time to plan their harvests and notify enforcement of when and where the landing will occur. Limiting the required landing notification should improve efficiency while providing time for enforcement offices to have appropriate staff in place. The cost to notify NOAA Fisheries Service would be the time required to radio or call the notification into enforcement,

Preferred Alternative 3(c)(3) would require that the aquaculture business maintain a record of the number of fingerlings placed in the facility. Knowing the number of fingerlings that are being raised allows enforcement to determine whether too many fish are being harvested. The costs incurred by the aquaculture firm to comply with this requirement should be small. If the firm purchases their fingerlings they will have sale receipts that document the number of fingerlings they purchased. Firm raising their own fingerlings, would likely count the fingerlings when pens are stocked. Determining the number of fingerlings stocked per pen would likely occur to ensure that the pens are stocked to the proper density to maximize production from the facility. The overall cost of storing the information in either case would be the time and filing supplies to maintain the data. For a six-cage system, these costs[55] should not amount to more than $20 per stocking of the cages.

Preferred Alternative 3(c)(4) requires the submission of fin clips from broodstock used in spawning of fingerlings. Enforcement could use the fin clips to obtain DNA or other material to

55 The cost of six file folders (one per cage), space in a file cabinet, and the time to file the folders. Alternatively the information could be stored on a computer and the overall cost would be even lower.

link the broodstock to the fish being raised at the facility. Those links would provide another enforcement measure to ensure that only fish from the aquaculture facility are being harvested and marketed by the firm.

Kits used to store DNA are available from various suppliers over the internet for less than $20. DNA kits proposed to be used by law enforcement offices in Maryland under Senate Bill 486 proposed in 2002 cost $3.5 each (http://mgadls.state.md.us/PDF-Documents/2002rs/fnotes /bil_0006/sb0486.PDF). The cost to store 100 samples for a year was $50 (http://www.analytical genetics.ca/pricelist.php). If four animals were needed for broodstock by a firm, the total cost of complying with this requirement could be less than $20 a year for materials, time, and transportation to the proper office. The cost to the government to store the samples could be about $50 per year per 100 broodstock.

Preferred Alternative 3(d) defines a use it or lose it provision for the aquaculture site. An offshore aquaculture permit, which grants a person the privilege to use a specified site for an aquaculture operation can be considered a tangible asset. In a private market setting, the price of a tangible asset (either sales price or lease price arrangement) will be directly related to its contribution to the output process (i.e., its marginal value product). If sold (leased) within a private market setting, therefore, the price that one would be willing to pay for a permit would relate to its ability to generate profits vis-à-vis other permitted sites.

Since the maximum amount that can be charged for a permit under the Magnuson Stevens Act, however, is limited to administrative costs associated with issuing the permit, one can envision applications for permits in excess of that number intended for near-term use. There are at least three reasons for this. First, an individual/group may apply for a permit with the anticipation of developing an offshore aquaculture operation at some (distant) future point in time (say, after sufficient capital is raised). The second reason is speculative activities among investors. Currently, this amendment does not include a provision for the transfer of permits. However if in the future transfers are allowed the speculator can, through the sale of the permit, earn the difference between what he is able to sell the permit for (i.e., the marginal value product of the permitted site) and what he paid for the permit (i.e., the application cost). A final reason why the number of applications may exceed the number intended for near-term use is that some individual/groups may simply be opposed to offshore aquaculture operations and, as such, apply for permits with no intention of using these permits for commercial offshore aquaculture.

Given the expected positive net national benefits associated with offshore aquaculture, one can conclude that actions limiting the ability of interested entrepreneurs from establishing operations in the near term will result in a reduction in net benefits. Hence, a provision that requires development of operations within two years of issuance of a permit is likely to provide positive benefits to society.

Preferred Alternative 3(e) would provide for additional permit conditions. The only options that would increase the costs beyond the typical paperwork requirements are **Preferred Alternatives 3(e)(iii)** and **3(e)(vii). Preferred Alternative 3(e)(iii)** requires that at least one locating device be attached to a cage or net pen. The type and cost of the pen-locating device that would be used by each firm, while not known with certainty, is likely to range from $350 to $1,450 per buoy.

Preferred Alternatives 3(e)(iv) and **3(e)(v)** would merely require a description of the types of harvesting equipment that will be used for harvesting the cultured product and conditions under which the aquaculture harvesting gear (or other fishing equipment) will be deployed. The costs of providing this information to NOAA Fisheries Service would be negligible yet this information can be used by enforcement to monitor harvesting operations in a cost-effective manner.

The intent associated with requirements specified in **Preferred Alternatives 3(e)(i), 3(e)(vi), 3(e)(viii),** and **3(e)(ix)** is to provide enforcement with information needed to better manage both offshore aquaculture industry and its interaction with the capture industry. **Preferred Alternative 3(e)(i)** would require the applicant to submit various information pertaining to vessels being used in aquaculture operation (e.g., names of captains and vessel owner, project vessel). Provision of this information will entail little cost to the firm yet enforcement can use it to ensure that operations being conducted by the vessel are consistent with aquaculture operations. **Preferred Alternative 3(e)(xi)** would require the permittee to notify NOAA Fisheries Service prior to removal of cultured fish from facility to shore. The cost of providing this information would be negligible yet the information will assist enforcement personnel in ensuring that wild harvest is not being commingled with (or substituted for) aquacultured product[56]. Similarly, prohibition of the possession of wild fish aboard any marine aquaculture facility, and its transport and service vessels, vehicle, or aircraft (i.e., **Preferred Alternative 3(e)(ix))** will help to deter commingling or substitution of wild product with aquacultured product and costs associated with this Alternative will be negligible.

Alternative 3(f) would merely allow the NOAA Fisheries Service RA to impose conditions in addition to those already specified, as deemed appropriate. Without additional information pertaining to what these conditions might be, it is impossible to determine whether this alternative would result in any significant increase in costs. Likewise, benefits are unknown.

6.4.3 Direct and Indirect Effects on the Administrative Environment

As stated in the discussion of Section 6.4.1, requiring conditions to be met prior to the issuance of a permit is primarily an administrative activity and would therefore have a direct effect on the administrative environment.

Alternative 1, the no action alternative, would allow the issuance of open ocean aquaculture permits to applicants without requiring any plans for the operation and management practices of the facility. This no action alternative would have the least amount of direct effect on the administrative environment, as it requires no development of a standardized form or follow up of a facility and its compliance with some set of conditions.

Alternative 2 would require any facility applying for an aquaculture permit to follow the guidelines at 50 CFR 600.745 (b). As discussed in Section 6.2.3, issuance of an EFP is a cumbersome, lengthy process, which negatively affects the administrative environment. Reviewing an application for an EFP, requesting additional information, and soliciting other

56 It also provides a timeframe from which enforcement can conduct inspection activities.

agency and public comment can take many months or longer before an EFP is issued. This not only negatively affects the administrative environment of NOAA Fisheries Service, but also that of other agencies.

Preferred Alternative 3 would create a set of conditions to be met by an aquaculture facility prior to a permit being issued for that facility. These conditions are described in Section 4.3. The conditions provided are designed to minimize impacts on the physical, biological, and ecological environment of the Gulf of Mexico, though they do so indirectly because review and compliance to a set of conditions is an administrative task.

All permit conditions set forth by **Preferred Alternative 3** require involvement of the administrative environment. The administrative environment will be responsible for verifying assurance bonds and reviewing the plans for limiting genetic impacts, aquatic animal health, environmental monitoring, compliance with law enforcement requirements, and emergency disaster plans. Additionally, the administrative environment will conduct on-site inspections of the facilities, both hatcheries and the systems used for grow-out. However, with the pre-developed conditions, applicants seeking an aquaculture permit would be able to provide the necessary information to the administrative environment in a more succinct and standardized manner, which would reduce the time it takes for the various administrative environments affected to review the applications. This would also reduce the burden placed on law enforcement officials who would be responsible for ensuring compliance. A standardized set of conditions across all facilities removes the ambiguity and uncertainty that may arise from individual, non-standardized issuance of permits, as would be seen through the use of an EFP-type permitting process.

The conditions set forth in **Preferred Alternative 3** can be divided into four categories: 1) ensuring biological integrity of wild stocks, 2) limiting environmental impacts, 3) aiding law enforcement, and 4) reducing user conflicts. Specific conditions for ensuring the biological integrity of wild stocks includes the identification of the source of broodstock, frequency of broodstock turnover, and plans for escapement events. Environmental impacts will be monitored by an environmental plan and the requirement to adhere to EPA standards, as well as emergency plans for hurricanes or other disasters, and the use of assurance bonds for removing equipment if an operation terminates. Law enforcement requirements include permits being carried by vehicles (boats, trucks, planes, etc.) used in aquaculture operations, notification of landing, records of the number of fish being grown-out, and submission of fin clips. User conflict is addressed by requiring permitees to begin operation of a facility within two years of issuance of the permit or the area established for the permit reverts back to an open access area.

Alternative 1 has the least direct effect on the administrative environment; however, this alternative would be expected to have a considerable negative indirect effect on the administrative environment. Without developing a standardized permit, which incorporates the standards of other agencies, aquaculture facilities would have to navigate the various authorities' processes for complying with the regulations under their jurisdiction in the open ocean. This would demand review by up to five different federal agencies and varying amounts of state agencies, dependent on the state. This review process could have a negative effect on these agencies' administrative environment. While a standardized permit is intended to expedite the review process of these agencies and decrease the burden placed on them.

This burden on the various agencies often results from a lack of familiarity by one agency of another agency's requirements and the concerns that may arise from the operation of an aquaculture facility. Therefore, not having standardized conditions, which satisfy all agencies that may be involved with aquaculture operations, could increase the burden on all agencies involved, negatively effecting the administrative environment. Additionally, if faculties were allowed to operate without these conditions, some may do so in a manner that is not sustainable to the environment they are operating. This could lead to decreased water quality, damage to habitat, or changes in wild populations. These worst case scenarios may place more burdens on the administrative environment in reversing these effects in the long-term than addressing the issues up-front and eliminating the potential for such operational downfalls.

Alternative 2 directly effects the administrative environment as discussed above, but also indirectly affects it by allocating resources (staff and time) to reviewing EFPs and moving those EFPs through the labor intensive procedure required for an EFP. **Preferred Alternative 3** does not indirectly affect the administrative environment. NOAA Fisheries Service intends to have a Regional Aquaculture Program Coordinator who is directly responsible for monitoring and evaluating aquaculture operations, and therefore that is the sole responsibility of that person and would not detract from any other responsibilities.

Although **Alternative 1** does not directly affect the administrative environment, the long-term consequences of not having permit conditions may be more burdensome than the other two alternatives. **Alternative 2** has proven to be onerous and burdensome on the administrative environment both directly and indirectly. **Preferred Alternative 3** while directly affecting the administrative environment provides the best solution for short-term and long-term burden placed on the administrative environment. The use of a specialized Program Coordinator will allow the development of an offshore aquaculture industry that is carefully monitored and held to standards set forth in this document. Therefore, the alternatives in order form most burdensome to least burdensome on the administrative environment are **Alternative 2, Alternative 1**, and **Preferred Alternative 3**. is the most burdensome who work on these EFP applications may be

6.5 Action 4: Species Allowed for Aquaculture

Action 4 includes 4 alternatives. **Alternative 1**, no action, would not specify which species could be used for aquaculture. **Alternative 2** would allow the culture of all species in the Gulf Council's reef fish and coastal migratory pelagics complexes, and red drum. Harvest of red drum is currently prohibited in the Gulf EEZ. Shrimp, spiny lobster, stone crab, and corals could not be used for aquaculture under **Alternative 2**. Commercial harvest of corals is currently prohibited in federal waters. **Alternative 3** would allow the aquaculture of all marine species managed by the Gulf Council, except shrimp, corals, and goliath and Nassau grouper. Harvest of goliath and Nassau grouper is currently prohibited in the Gulf EEZ. **Preferred Alternative 4** would allow the aquaculture of all marine species in the Gulf of Mexico managed by the Council, except shrimp and corals, and includes a request to the HMS division of NOAA Fisheries Service to allow the culture of species managed under their authority (tunas, billfish, sharks, and swordfish). No non-native or genetically modified species would be allowed under this alternative.

6.5.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

Determining what species are permissible for aquaculture activities could have both direct and indirect effects on the physical, biological, and ecological environment. The first factor to consider in determining allowable species is impacts to wild stocks. These impacts are discussed in Section 6.1.1, and briefly revisited here. **Alternative 1** is the only alternative that would allow for non-native species and/or genetically modified species to be used in aquaculture operations. As discussed in Section 6.1.1 there are numerous factors to consider when examining the impacts of the introduction of non-native species to a local environment. These factors include species selection, source of broodstock, location, composition of wild stock, etc. In an attempt to limit the potential impacts of such introductions, the Council chose to develop the other alternatives limiting the species to native, non-genetically modified organisms. The difference between **Alternatives 2**, **3**, and **4** is only in the number of species allowed for aquaculture, not the origin of the species. Shrimp and coral are excluded from all alternatives, except **Alternative 1**. Therefore, the effect on the biological, physical, and ecological environment is expected to be similar for these alternatives. Thus, the impact to the wild stocks is not expected to come from the introduction of non-native species. Instead, the impact to the wild stock populations would come from two other sources. The first is from competition from con-specifics that escape aquaculture facilities and interact with their wild counterparts. This potential impact is discussed in Section 6.1.1.1. The second potential impact comes from the collection of broodstock for use in hatchery operations. Any harvest of broodstock will be regulated under the authority of the MSFCMA, and therefore harvest will be constrained to the current regulations developed under the FMP for a particular species. Therefore, the harvest of broodstock is expected to have minimal impacts on the wild populations, as only a relatively few number of individuals is required for hatchery purposes at any given time. Selecting **Alternative 2**, **3**, or **4** would therefore have less effect on the physical, biological, and ecological environment than **Alternative 1** when examining the impact on wild stocks.

Another factor to consider in determining species allowed for aquaculture is the potential to create loopholes or opportunities for poaching to occur. The alternatives under consideration do not specify how many specimens would be taken. Instead, they differ in the number of species that could be cultured. **Alternative 1** would allow the greatest number of species to be cultured and so would potentially cause the greatest opportunity for poaching to occur. The remaining alternatives, in decreasing number of species allowed for culture and associated risk, are **Alternatives 2**, **3**, and **4**. **Alternative 3** would best protect recovery of goliath and Nassau grouper by preventing a means of illegal sale of wild-caught species. Legal sale of cultured goliath and Nassau grouper, which could occur under **Alternatives 1**, **2**, and **4**, could make it easier to sell illegally harvested fish by fraudulently marking them as "cultured." Similarly, **Alternative 2** would best prevent harvest of wild corals by preventing a potential means of illegal sale of these species. Sale of illegally harvested red drum as "cultured" would be possible under all alternatives. However, the potential for illegal sale is greatly decreased by the permit conditions developed under Action 3. The conditions developed for improving law enforcement capabilities were a direct result of the concerns of creating opportunities for illegal sales of fish in the marketplace under the pretext of those sales being cultured fish. By providing law enforcement the necessary tools for determining the origin of cultured species (submission of fin clips), agents can discern if in fact individual fish are products of aquaculture facilities.

The culture of species that are more susceptible to illegal sales, may ultimately lead to a reduction in those illegal sales. As aquaculture begins to provide a product for which there is a demand, there will be less incentive for poachers to continue operating and targeting those species. If this is true, then **Preferred Alternative 4** would provide the greatest benefit to the physical, biological, and ecological environment of the Gulf, with **Alternative 3** and **Alternative 2** providing decreasing benefits, respectively. **Alternative 1** would be expected to have the same benefits for species native to the Gulf as **Preferred Alternative 4**, but the potential to introduce non-native species makes this a riskier alternative and potentially not as beneficial to the physical, biological, and ecological environment.

Production of native species through aquaculture could result in a net biological benefit to the species and their ecosystems by creating a new source of seafood which could reduce the amount of fishing pressure on the wild GOM stocks. **Alternative 1** would allow culture of non-native species. Production of these non-native species would not as readily reduce demand for wild-caught native species as would production of native species. The more native species allowed for culture by a particular alternative, the more chances for relief from fishing pressure for those species. The remaining alternatives, in decreasing number of species allowed for culture and potential positive effects to wild populations from less fishing pressure, are **Alternatives 2**, **3**, and **4**. It must be noted, however, that differences in public demand for cultured versus wild fish could influence the extent of any reduction in fishing pressure on native stocks.

6.5.2 Direct and Indirect Effects on the Economic and Social Environment

The Council is considering three alternatives with respect to the species that will be allowed for aquaculture in addition to the status quo. Alternatives under consideration are presented in this section, and to the extent possible, a qualitative discussion of the economic impacts associated with selecting each alternative is provided

Currently, the only legal avenue for EEZ aquaculture is under an Exempted Fishing Permit, as provided for under 50 CFR 600.745. Language of the EFP requires that applicants specify "[t]he species (target and incidental) expected to be harvested under the EFP, the amount(s) of such harvest necessary to conduct the exempted fishing, the arrangements for disposition of all regulated species harvested under the EFP (50 CFR 600.745)." The historical basis for the EFP does not include offshore aquaculture and, hence, there is no language regarding what species would be permitted. Hence, the status quo (**Alternative 1**) would include all species whether or not managed by the Gulf Council and even non-indigenous species[57].

This alternative would allow for the aquaculture of most species managed by the Gulf of Mexico Fishery Management Council[58]. Four primary species – spiny lobster, stone crab, corals, and

57 This does not imply that non-indigenous species would be allowed in offshore aquaculture since (a) the Regional Administrator, Director, or his designee has latitude on approving the EFP and (b) the USFWS and NOAA co-chair the federal Aquatic Nuisance Species Task Force established to develop a program to prevent, monitor, control and study aquatic nuisance species. Therefore, one would believe that the Regional Administrator would not approve any EFP that included the introduction of a non-indigenous species.
58 A list of all stocks (and species in the respective management units) can be found in Appendix A of this Amendment (Note: this needs to be checked to see if it is still Appendix A)

shrimp – would be excluded. While one can be relatively certain that there will be no demand for offshore aquaculture of shrimp and corals, one can not be as certain regarding spiny lobster and stone crab.

Alternative 3 is somewhat more flexible than **Alternative 2** in that it would also allow for EEZ aquaculture of spiny lobster and stone crab. However, it would preclude the aquaculture of both goliath grouper and Nassau grouper.

Of the four alternatives under Action 4, **Alternative 1** is, at least in theory, most inclusive[59]. It includes all species native to the Gulf of Mexico (i.e., **Preferred Alternative 4**) as well as non-indigenous species. **Preferred Alternative 4** would allow for the aquaculture of all marine species native to the Gulf of Mexico that are managed by the Council, except shrimp and corals. The Council would also request that NOAA Fisheries Service develop a concurrent rule for HMS.

When comparing **Alternatives 2-4** one must consider whether there will be demand for those species if firms raise them. If there is no demand (current or near future), one can conclude that both the benefits and the costs associated with the alternatives are identical. If there is a demand, however, one can assume that entrepreneurs believe that profit can be earned from growing species allowed under the more liberal alternatives. In this situation, one can conclude that producer surplus associated with the more liberal alternatives would be greater than that associated with more restrictive alternatives and that consumer surplus will either remain unchanged or will increase[60]. As discussed under Action 2, external costs associated with offshore aquaculture are not anticipated to be excessive.

Hence, one can conclude that the Net National Benefits associated with more liberal alternatives exceed those of more restrictive alternative if there is a demand by entrepreneurs for growing species that would not be allowable under some alternatives. If there is little or no demand, the Net National Benefits of adopting less restrictive option are equivalent to those expected by adopting a more restrictive alternative.

Since **Alternative 1** could include non-indigenous species, some additional discussion is warranted. Issues/concerns associated with the introduction of non-indigenous species are covered in Section 6.1. While there are additional risks, we as a society take risks every day. The economic issue with respect to offshore aquaculture is whether the potential benefits associated with the introduction of non-native species versus the costs. If there is no demand by

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59 The qualifying term "in theory" is used here because the USFWS and NOAA co-chair the federal Aquatic Nuisance Species Task Force established to develop a program to prevent, monitor, control and study aquatic nuisance species, and neither agency, in principle, would favor the use of non-native species for aquaculture. The Gulf Council Offshore Aquaculture Advisory Board is on record of being opposed to the introduction of any non-native species.

60 See Action 2 for a more complete discussion of expected changes in producer and consumer surplus. As noted in reference to that Action, the reduction in producer surplus in the related capture fisheries is expected to be relatively small given the fact that the current management regimes for Council managed fisheries do not attempt to maximize producer surplus. Hence, it is expected that gains in producer surplus from offshore aquaculture facilities will exceed reductions in producer surplus by the fishing sector. In addition, producer surplus in related sectors (e.g., processing) will likely be enhanced.

entrepreneurs for raising these species in the Gulf, then benefits would be zero and costs would be zero[61]. If there is demand, however, there would likely be benefits in the form of increases in consumer and producer surplus. If some of the concerns regarding the introduction of non-indigenous species come to fruition, however, external costs could, potentially, be high. Therefore, it is prudent to understand the potential impacts non-indigenous species could have on the ecosystem before they are introduced. If the potential costs to society are high, it may warrant a risk adverse approach to protect the ecosystem from their introduction at the expense of increased consumer and producer surplus. In the absence of any information on (a) probability of occurrence of a negative environmental impact (e.g., disease, impact of escapement on carrying capacity and wild stocks, etc.) and (b) the costs to society if this impact were to occur, however, it is impossible to judge whether benefits exceed costs[62]. Hence, it is impossible at this point to compare Net National Benefits under the status quo (**Alternative 1**) with Net National Benefits associated with any of the other alternatives.

6.5.3 Direct and Indirect Effects on the Administrative Environment

As described above, **Alternative 1**, which would allow culture of non-native species, carries the highest risk of problems due to escapement of cultured fish and their detrimental effects on native stocks and ecosystems. If such escapement occurred, but the company did not go out of business, the regulations resulting from this amendment would require the company to attempt to recapture the fish or otherwise remedy the effects of the escape through direct action. Because the other alternatives do not allow culture of non-native species the negative impacts of accidental escapes on the stocks and ecosystem would be much less, as would the likelihood of agency action in response to such escapes.

Culture of goliath grouper, Nassau grouper, red drum, and/or corals could result in an enforcement issue if illegally harvested animals are sold as cultured animals. Choice of **Alternative 1, 2,** or **4**, which would allow culture of goliath and Nassau grouper, could result in increased administrative costs due to enforcement of regulations and prosecution of violators. **Alternative 3**, which would prohibit culture of these species of grouper, would not cause these expenses. **Alternative 2** prohibits culture of spiny lobster, stone crab, and corals, so it would not cause administrative costs from addressing illegal sale of corals. Measures which would allow culture of corals, could cause such costs.

6.6 Action 5: Allowable Marine Aquaculture Systems

Alternative 1 is status quo, which does not specify the types of marine aquaculture systems allowed in the GOM. **Alternative 2** would allow only cages and net pens in offshore aquaculture. **Alternative 3** would allow cages and net pens, plus those systems used for invertebrates. **Preferred Alternative 4** would not authorize (or prohibit) specific systems. Instead, NOAA Fisheries Service would evaluate the marine aquaculture system proposed in each permit application on a case-by-case basis.

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61 One might argue that species native to the Gulf, since they are suited to the climate regime, represent candidates that would yield highest profits.

62 One might expect that USFWS and NMFS would oppose the introduction of any non-indigenous species in principle.

6.6.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

Though determining what is considered an allowable marine aquaculture system is administrative in nature, it can have effects on the physical, biological, and ecological environment. An acceptable aquaculture system must be: 1) robust enough to withstand open Gulf conditions (including hurricanes) without breaking apart, 2) effective in retaining fish or invertebrates, and 3) effective at preventing environmental pollution. If a system does not meet these standards it will affect the environment. **Alternative 1** does not specify aquaculture systems, nor does it provide guidance for evaluating systems proposed by aquaculture operations. This lack of guidance may allow systems to be used, which do not meet the three key factors in determining an effective system listed above. This could lead to negative impacts on the physical, biological, and ecological environment.

Alternative 2 would not allow systems other than net pens or cages to be deployed, which would be evaluated for robustness, prevention of escapement, and prevention of environmental damage by the ACOE under the Rivers and Harbors Act. **Alternative 2** would prevent the use of any system developed using technology not yet invented which did not meet the definition of a net pen or cage. Such a new system could be far superior to net pens or cages for environmentally safe marine aquaculture. **Alternative 3** is expected to have similar effects as **Alternative 2** because it allows the use of the same cages and pens, but also allows the use of systems designed for the culture of invertebrates. The limiting of systems to those already developed or used for single species culture may prevent the use of technologies forthcoming that are superior in design and function to those that exist. Choice of **Alternative 1** would be worse than **Alternatives 2** or **3** because it allows any and all types of systems to be used, whereas **Alternative 2** and **3** at least allow only systems that have been used and been shown to be reliable.

Alternative 4 would base approval not on the type of system proposed but on a case-by-case evaluation by NOAA Fisheries Service of the soundness of the proposed design. This is expected to be the best alternative with the least effects on the physical, biological, and ecological environment. As new technologies are developed and unique niches exploited in the aquaculture industry, a case-by-case review will allow NOAA Fisheries Service to examine the appropriateness of a system to its application while examining the impacts to the physical, biological, and ecological environment. Therefore, the alternatives in order of least effects on the physical, biological, and ecological environment to the most effects are **Preferred Alternative 4**, **Alternatives 2** and **3**, and **Alternative 1**.

6.6.2 Direct and Indirect Effects on the Economic and Social Environment

Action 5 consists of three alternatives and the status quo. **Alternative 2** would allow only the use of cages and net pens in offshore aquaculture. While the verbiage associated with **Alternative 3** is somewhat nebulous in nature, a literal interpretation would tend to imply that any system would be permitted. If this interpretation is correct, **Alternative 3** provides a great deal of flexibility to the entrepreneur in that no restrictions are placed on the type of aquaculture system that would be allowed. **Preferred Alternative 4** does not restrict the types of aquaculture

systems that may be used, but explicitly requires NOAA Fisheries Service to review each application to ensure that the system provides environmental safeguards.

Currently, the only legal avenue for EEZ aquaculture is under an Exempted Fishing Permit, as provided for under 50 CFR 600.745. Allowable gears (systems) are not specified in the EFP and, hence, the status quo (**Alternative 1**) is, presumably, equivalent to **Alternative 3**. Hence, discussion of **Alternative 3** will serve also for the discussion of the status quo[63].

Alternative 2 limits the prescribed systems to two types: cages and net pens. **Alternative 3** would, presumably, allow for any system, including non self-contained systems. The full complement of growout systems, given by Cicin-Sain et al. (2005), is as follows (p.14)[64]:

Shellfish culture:

(a) Floating longlines or hanging cages or lantern nets;
(b) Free planted –"bottom ranching"
(c) Bottom cages

Finfish culture: Either the conventional rearing of hatchery-reared fingerlings or for "fattening to add value to wild harvest fish (such as tuna)

Including: traditional floating pens
Submersible
Possible mobile

"Ranching"

Release of juveniles that either return or are "trained" to aggregate for harvest

Seaweed culture

Longlines for aquatic plants

As indicated, **Alternative 2** would include all systems currently used for finfish culture with the exception of "ranching[65]." **Alternative 2**, however, would preclude certain types of systems that may be feasible for the culture of shellfish species and plant species[66]. **Preferred Alternative 4** is similar to **Alternative 3** in terms of the types of aquaculture systems that may be employed,

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63 As indicated in the minutes of the January 2007 Gulf of Mexico Fishery Management Council Joint Reef Fish/Mackerel/Red Drum Committees meeting, Dr. Keithly raised the issue as to whether Alternative 1 and Alternative 3 are equivalent. He stated "[a]alternative 1 is the status quo, which if I interpret it correctly, working under the EFP, there is no gear specified and so in fact, it becomes the equivalent to Alternative 3, which would, in essence, allow any gear to be used for offshore aquaculture in the Gulf of Mexico (p. 26)." A review of the minutes suggest that the Council members did not disagree with this interpretation.

64 Not included in this list are nursery facilities and hatchery facilities. These may be required for offshore aquaculture by may be land based.

65 Unless Action 4, Alternative 1 is selected, ranching (as defined by the release of juveniles that either return or are "trained" to aggregate for haravest) is likely not a viable option for Gulf offshore aquaculture. Furthermore, the number of species where ranching is applicable appears to be very limited and (a) these species may not survive in the Gulf climate and (b) it is unlikely that NOAA Fisheries Service would allow their introduction for purposes of offshore aquaculture. However, free planted "bottom ranching" or species, such as sponges, corals, or clams that are native to the Gulf would be possible.

66 Plant species, as defined here, include invertebretes such as sponges.

but explicitly requires NOAA Fisheries Service to review the proposed system to ensure that it provides adequate environment protections. Therefore, if the applications submitted provide reasonable environmental safeguards, the economic impacts of **Alternative 3** and **Preferred Alternative 4** should be approximately the same. Given the similarity of the alternatives, the discussion of impacts under **Preferred Alternative 4** may also be applied to **Alternative 3** and **Alternative 1**.

To address the issue of Net National Benefits associated with **Preferred Alternative 4** (including **Alternatives 1 and 3**) in relation to **Alternative 2** it is useful to examine benefits and costs separately. Benefits, as previously identified, represent increases in producer, consumer, and third party surpluses. With respect to producers (in both the primary and secondary markets), the issue becomes one of whether profits would be higher under **Preferred Alternative 4** than under **Alternative 2**. With certainty, one can state that expected profits under **Preferred Alternative 4** would be no less than under **Alternative 2**[67]**.** If there is a demand for the products that can be grown with systems not included in **Alternative 2**, however, and the demand is sufficient such that the output price covers all costs, then profits associated with **Preferred Alternative 4** will be higher than those associated with **Alternative 2**[68]**.** Furthermore, there is likely to be "jointness" in production activities between different systems. For instance, given the very high upfront costs and annual variable expenses, it seems reasonable to assume that several different growout systems may be used on any given site. Spreading these fixed and variable costs across systems will provide economies of scale implying higher returns per unit output. Hence, one can conclude that if there is a demand for output that can be grown in a system that would be allowed under **Preferred Alternative 4** but not **Alternative 2**, then producer surplus to offshore operations would be higher under **Alternatives 4** than **Alternative 2**. Finally, since producer surplus under **Preferred Alternative 4** is likely to exceed that of **Alternative 2**, one can conclude that investment would be enhanced is **Preferred Alternative 4** is adopted.

Depending upon the decline in imports in association with increased aquaculture output, there may or may not be losses in producer surplus in the captured harvesting sector. As previously discussed, if the imported product is a perfect substitute for the domestic product, welfare losses in the domestic harvesting sector (i.e., producer surplus) will, in theory, be zero. If imports

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67 Specifically, if expected profitability from the use of these systems is zero or negative, entrepreneurs will not employ them. In this situation, the implications of adopting Alternative 3 are identical to those associated with Alternative 2.

68 While not discussed here, it is also possible that the costs of growing an additional species (which would not be technologically feasible under Alternative 2, may be close to zero. For example, since sponges, corals, and mollusks are filter feeders, they may be able to survive and grow to market size simply by feeding on the waste food particles and fecal material that falls out of the water column (assuming they cultivated on a bottom ranching system). Similarly, Kolian and Sammarco (2005) report that many species including sponges, sea fans, and soft corals are known to live on existing oil-and-gas platforms. Presumably, they would also grow on platforms developed in association with cage culture. Alternative 3 would allow the harvest of these species (depending upon the Alternative selected under Action 4) at little or no additional costs while harvest of these species might be prohibited under Alternative 2 (at a minimum, current commercial fishery regulations would apply). As a final example, Dougall (1998) discusses the harvest of mussels that attach themselves to oil-and-gas platforms in California. Historically, these mussels were removed at considerable cost (a few hundred thousand dollars every few years) to maintain the structural integrity of the platform. Subsequently, a California firm capitalized on the opportunity by harvesting the product and selling it to restaurants; a considerable cost savings to the energy companies.

constitute an imperfect substitute, there is likely to be some reduction in profits to the domestic harvesting sector. Similarly, if imports and domestic products are perfect substitutes, there will be no gains in consumer surplus. If imperfect substitutes, however, consumers are likely to gain.

As indicated in Section 5.3, imports of many species that compete with wild Gulf production are large and increasing (e.g., shrimp, snappers, groupers). Furthermore, while import data on other species harvested from the Gulf (e.g., cobia) are not disaggregated to the degree needed to ascertain trends in these products, it seems likely that imports of species such as cobia are increasing. Where information is available, furthermore, price of the imported fresh product tends to "mirror" the dockside price of the domestic product; providing *prima facie* evidence that imported products are relatively close substitutes for the domestic product, if not perfect substitutes. Hence, one is led to conclude that offshore aquaculture production may exert relatively little downward pressure on the dockside price of the domestically produced product. If this is the situation, then that Alternative which would generate the greatest amount of producer surplus to the offshore aquaculture sector would also likely provide the greatest net impact to coastal communities in terms of job creation (i.e., **Alternative 3** and **Preferred Alternative 4).** Finally, there would likely be little differences in external benefits between **Alternative 2** and **Preferred Alternative 4**.

There are three cost components that detract from welfare: private costs, external costs and administrative costs. Private costs are those internal to the operation. While private costs under **Preferred Alternative 4** are likely to be somewhat higher than under **Alternative 2** (assuming that there does not exist perfect jointness in production where some products are produced with no additional costs), the additional costs would be incurred only if it increased profits. Hence, one can conclude that from the producer's side any increase in costs will be covered by increased revenues.

Since **Preferred Alternative 4** subsumes Alternative 2, it is also clear that external costs to society associated with **Preferred Alternative 4** will, in general, be at least as large as those under **Alternative 2**[69]**.** However, as previously noted (see Action 3), external costs with offshore aquaculture are thought to be relatively manageable. This may be particularly the case with some types of systems not permitted under **Alternative 2**. For example, concerns associated with navigational hazards may be lessened with some of the systems associated with Alternative 3. One possible external cost of relevance, however, reflects reduction of genetic diversity[70]. Specifically, Alternative 3 would allow for non self-contained systems. While there will undoubtedly be escapement from contained systems (nets and pens), significant escapement will be the exception rather than the rule. Depending upon the source of brood stock, one can ague that changes in genetic diversity of the wild stock may be greater under **Preferred Alternatives 4** than under Alternative 2.

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69 There is at least one possible exception to this general rule. Theoretically, growing species that would be technically unfeasible in the absence of Alternative 3 with those that would be technically and economically feasible under Alternative 2 may reduce external costs. For example, if filter feeders grown in a bottom ranching system assist in removing wastes (food pellets, fecal matter, etc.) associated with those species grown in a system allowed under Alternative 2, external costs may fall.

70 It is assumed here that non-indigenous species (See Action 4, Alternative 1) would not be permitted in a non self-contained system.

Overall, an analysis of this Action leads one to conclude that, under some assumptions, Net National Benefits under **Preferred Alternative 4** exceed those under **Alternative 2**. Speculative conditions include the following: 1) there is a demand for species that can be grown under Alternative 3 that can not be grown under **Alternative 2**, 2) such growout systems are profitable, 3) that external costs associated with Alternative 3 are not significantly higher than those associated with **Alternative 2**, and 4) that administrative costs are not excessive. All of these assumptions, while somewhat speculative, appear reasonable. If there is demand, one can also conclude that investment under **Preferred Alternative 4** will exceed that under **Alternative 2**.

6.6.3 Direct and Indirect Effects on the Administrative Environment

Alternatives 1, **2**, and **3** would not require any NOAA Fisheries Service review of the proposed system before it was deployed, so they would directly affect the administrative environment the least. **Preferred Alternative 4** would require direct review of each system proposed and would therefore directly affect the administrative environment more than the other alternatives.

However, the lack of oversight in system allowance as proposed under **Alternatives 1**, **2**, and **3** may lead to indirect effects on the administrative environment. If systems are used that are not properly suited for handling the rigors of the offshore environment, more system failures would be expected. This could lead to huge increases in demand on the administrative environment as mitigating efforts must be developed and implemented. **Preferred Alternative 4** is not expected to encounter these types of problems as any uncertainty in the use of systems would be addressed in the initial review of a proposed system. Therefore, **Preferred Alternative 4** would have the least impact on the administrative environment in the long-term, while **Alternatives 1**, **2**, and **3** are expected to have similar effects on the administrative environment.

6.7 Action 6: Designation of Sites or Areas for Aquaculture

Action 6 includes four alternatives. **Alternative 1**, no action, would not designate areas in the Gulf EEZ where aquaculture would be allowed. **Alternative 2** would establish marine aquaculture areas. Marine aquaculture would not be limited to these areas. However, if a facility was proposed to be sited in one of these areas, approval of the permit would occur more quickly. Rather than establish marine aquaculture areas, **Alternative 3** would establish possible criteria to be used when evaluating siting of proposed aquaculture facilities. These criteria would be used by NOAA Fisheries Service to evaluate each proposed location identified in a permit application on a case-by-case basis. **Preferred Alternative 4** uses the criteria established under **Alternative 3**, but also defers to the authority of other agencies while acknowledging the potential for those agencies' regulations to change over time (i.e., allows flexibility to meet other agencies' needs and changes).

Regardless of the alternative selected in this Amendment/EIS, the ACOE still has the authority to issue siting permits under its current authority. **Alternative 1** acknowledges this authority and defers to ACOE. However, the Council and NOAA Fisheries Service may have other criteria that would not be considered by the ACOE and therefore selecting an alternative that incorporates these criteria seems more prudent. **Alternative 2** would create aquaculture zones, where facilities may operate. Though not restricted to just these sites, choosing to establish a

facility within these sites would expedite the approval process for siting. The problem with **Alternative 2** would be in continuously updating these reference maps for acceptable locations of siting facilities. With the number of agencies that have authority in the EEZ, this is a monumental task to accomplish Gulf-wide given the probability that only select areas will be used for aquaculture within the Gulf..

Alternative 3 uses a list of criteria as compiled from both other agencies and with criteria that the Council and NOAA Fisheries Service considers important from their management of domestic wild-caught fisheries management. These criteria are listed in Table 6.7-1. The problem with this approach is similar to the pre-defined areas. Management is fluid, whether it is under the authority of NOAA Fisheries Service and the Council or under the authority of another Agency. Therefore, any alternative that locks in criteria or sites will at times require extensive processes to accommodate these changes.

Preferred Alternative 4 was developed in recognition of this ever changing regulatory environment and tries to accommodate the potential changes to the best extent possible, while still providing a list of current criteria that will be examined during the review of a facility's siting. This approach makes clear certain expectations (by providing a list), while acknowledging that over time, other considerations will need to be examined and incorporated into the decision making process when siting a facility.

Table 6.7-1: Criteria of NOAA Fisheries Service and other agencies for siting aquaculture facilities/systems, and the agency/agencies responsible for evaluating each criterion.

Criterion	**Agency**	**Is this prohibition required by existing regulations?**
Dissolved oxygen consistently high enough to sustain life.	EPA	No
Current sufficient to remove waste materials but not high enough to damage structures	EPA, NOAA Fisheries Service, Army Corps of Engineers (Corps)	Yes
Water depth and clearance sufficient for proposed system	Corps, USCG, NOAA Fisheries Service	Yes
Sediment type meets the mooring needs for proposed system	Corps, NOAA Fisheries Service	No
Not located in or within a certain distance of:		
dredge spoil disposal area	Corps	Yes
oil or gas platform, unless owner agrees, but the Energy Policy Act of 2005 specifically addresses aquaculture on oil and gas platforms, Regulations are being developed by MMS	Mineral Management Service (MMS)	No

Criterion	Agency	Is this prohibition required by existing regulations?
Federally recognized marine reserve, marine protected area, habitat area of particular concern, government or public artificial reefs	National Ocean Service (NOS); NOAA Fisheries Service	No
Ecologically important habitat (e.g., coral reefs, hard bottom)	NOAA Fisheries Service	No
"No Activity Zones"	MMS, NOAA Fisheries Service	Yes
shipping fairway, navigational channels, federal channels, anchoring areas, lightering area	US Coast Guard (USCG)	Yes
traditionally important fishing area	NOAA Fisheries Service	No
area of frequent harmful algal blooms	EPA, NOAA Fisheries Service	No
seagrass bed	NOAA Fisheries Service	No
military activity zone	Corps, DOD	Yes
oil pipeline	Corps, MMS	Yes
wind farm	Corps, MMS	Yes, but regulations are being developed which may change this
liquefied natural gas facility or pipeline	Corps, MMS	Yes
Important nursery habitat; known spawning areas	NOAA Fisheries Service	No

If the Council wishes to prohibit aquaculture activities in any particular area, it may do so in this amendment by including them in the siting criteria to be used by NOAA Fisheries Service for review of aquaculture permit applications. The Council could prohibit aquaculture activities in HAPCs, MPAs, and SMZs. Fishing is restricted in these areas, but current regulations could still allow aquaculture to occur in some cases. The Council could also restrict aquaculture activities over seagrass beds, over hard bottom, in traditionally fished areas, and/or in areas of frequent harmful algal blooms, as suggested in Section 5.1.4, or in any other area they deemed appropriate.

6.7.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

If **Alternative 1** were chosen, NOAA Fisheries would evaluate each proposed site by commenting on the ACOE's Section 10 permit application. This permit is required before constructing an offshore aquaculture facility. The ACOE must consider "…a broad range of potential environmental and other impacts…" before issuing a Section 10 permit, including "…water quality, pollution, economic factors, safety, accurate charting of any structures, aesthetics, navigational integrity, and the effects of the structure on recreation, fish, and other wildlife (33 CFR 320.4)." However, the ACOE's evaluation of the effects of the structure may not address factors NOAA Fisheries Service considers critical. NOAA Fisheries Service could not easily obtain this additional evaluation from the applicant since the ACOE would administer the application. In addition, if NOAA Fisheries Service had concerns about the permit application not shared by the ACOE, these concerns would not necessarily be addressed by the ACOE or the applicant before the Section 10 permit was issued; however, this is unlikely as NOAA Fisheries consults with the ACOE under the MSFCMA, ESA, and MMPA.

Alternatives 2, **3**, and **4** would be better than **Alternative 1** in that all three would allow NOAA Fisheries Service to evaluate the suitability of a proposed site and its potential impacts to the physical, biological, and ecological environment. However, **Alternative 2** would not allow NOAA Fisheries Service to evaluate the characteristics of a potential site on more than a broad scale. If a proposed site were not in the previously evaluated "marine aquaculture areas," **Alternative 2** would not allow for any evaluation of the proposed site. **Alternative 3** would more effectively identify unacceptable sites by evaluating each on a case-by-case basis. Therefore, it is less likely to result in negative impacts to the physical, biological, and ecological environment.

Any evaluation of whether a proposed site is appropriate for placement of an offshore aquaculture system must consider whether the abiotic aspects of the site, such as current velocity, dissolved oxygen, nutrient levels, etc. are acceptable. If they are not, the potential negative effects to the biological, physical, ecological, or administrative environments may outweigh any positive effects of the proposed system on the economic or social environments. It may seem prudent to set specific allowable levels for these abiotic factors in this amendment, through specification of these levels as part of **Alternative 3** to this action. However, it would be impossible to set acceptable levels which would apply to any site in the Gulf of Mexico, because the Gulf of Mexico is a very complex system. In addition, a review of the scientific literature would not provide such levels that could be agreed to by all scientists because not enough research has been done to establish such levels. Further, factors such as the number of aquaculture structures and the distance between them, the species of fish to be cultured and the deposition rate of its fecal material, and the depth of a structure and how the current responds to it are specific to the proposed site and system design. For example, an acceptable current velocity in one area of the Gulf of Mexico may be unacceptable elsewhere depending on the underwater characteristics at the site. Therefore, a statement that the current velocity must be between "x" and "y" may not prove to be very useful. Detailed analysis of each possible site, system, and species in this amendment, and all the combinations thereof, is impractical. Even if it were practical, aquaculture systems developed based on future technology, and species not yet studied for aquaculture, could not be evaluated at this time.

Preferred Alternative 4 is similar to **Alternative 3**, but provides more flexibility to accommodate changes in management from both NOAA Fisheries Service as well as other agencies that have authority in the EEZ. **Preferred Alternative 4** will require each facility to be examined on a case-by-case basis using a limited set of criteria (Table 6.7-1) while still allowing other factors, including regulatory changes to be examined when reviewing each facilities siting request. This requirement to meet certain siting conditions prior to and during siting and operation of a facility will provide the best assurance that a facility operates with the least impacts to the physical, biological, and ecological environment. Therefore, alternatives in order from least likely to have negative effects on the physical, biological, and ecological environment to most likely are **Preferred Alternative 4**, **Alternative 3**, **Alternative 2**, and **Alternative 1**.

6.7.2 Direct and Indirect Effects on the Economic and Social Environment

Action 6 includes two alternatives and the status quo that address aquaculture sites.

This alternative would continue to allow any entity to place an offshore aquaculture structure for any location the ACOE would issue a permit. Maintaining the status quo (**Alternative 1**) will result in no changes in Net National Benefits.

This alternative would begin to create designated areas (zones) for offshore aquaculture. Other activities in these areas may, or may not be, restricted. Finally, while aquaculture operations would not be limited to these areas, review of permit applications for a site within these areas would be reviewed more rapidly than permit applications outside the designated areas. There are at least two potential benefits to establishing designated aquaculture areas. First, there is the potential to reduce user conflicts if the designated sites are established in areas outside of areas heavily used in other activities (e.g., commercial fishing or recreational fishing). Second, proper siting of these designated areas can help to ensure ecosystem integrity.

Given that aquaculture operations would not be limited to marine aquaculture areas, there are few if any direct additional costs (relative to the status quo) to business ventures considering offshore operations (other than a delay in the application review). Likewise, however, additional benefits (relative to the status quo) may be few. Specifically, any benefits that might be realized under a true zoning process would tend to be dissipated by entrepreneurs applying for permits and eventually developing facilities outside of the designated areas.

Overall, without additional information it is impossible to state that any benefits would be forthcoming from the establishment of these (voluntary) designated areas. To some extent, it would depend on whether applications would be made for space within the designated areas. If the areas that are eventually designated are outside the areas desired by the potential aquaculture businesses, then one is led to conclude that their applications will be for sites outside the designated areas. In such a situation, benefits would be zero.

While benefits would be zero, this does not necessarily imply that costs will also be zero. Specifically, if other uses of the area are restricted, costs to other users of the ocean space in the designated area would increase (assuming that there are other users). As one example, if the designated areas displace traditional fishing areas of either commercial or recreational fishermen,

there will be some dislocation costs[71]. In this situation, Net National Benefits would decline. Costs would be zero, however, if there were no other uses for the designated areas[72].

In summary, one cannot conclude that that the Net National Benefits associated with **Alternative 2** are greater than those associated with the status quo (**Alternative 1**). If restrictions are placed on other uses in these designated areas, one can conclude that the National Net Benefits associated with Alternative 2 may be less than those associated with the status quo.

Section 10 of the RHA prohibits "the creation of any obstruction" to navigation within state and federal waters. Therefore, as noted by Welles (2005):

> "… an applicant must obtain a Section 10 permit from the ACOE before constructing an offshore aquaculture facility. Prior to issuing a Section10 permit, the ACOE must consider "a broad range of potential environmental and other impacts[73]." The potential environmental impacts include: water quality, pollution, economic factors, safety, accurate charting of any structures, aesthetics, navigational integrity, and the effects of the structure on recreation, fish, and other wildlife[74].

Based on this, one can conclude that the ACOE uses a set of criteria when reviewing applicants. These criteria, as noted, include (a) the relevant extent of public and private needs, (b) where unresolved conflicts of resource use exit, the practicability of using reasonable alternative locations and methods to accomplish project purposes, and (c) the extent and performance of the beneficial and/or detrimental effects the proposed project may have on public and private used to which the area is suited

While this might be the case, the set of standards used by the ACOE are not specified in detail which may lead to uncertainty on the part of potential investors in offshore aquaculture. **Alternative 3** would, presumably, provide a clear set of standards and the standards set by NOAA Fisheries Service (and the Council) may be more restrictive than those set by the ACOE.

Specifically, adopting this Alternative would not negate the need for the applicant to obtain a Section 10 permit from the COE and if some aspects of the ACOE criteria are more stringent than those developed by NOAA Fisheries Service, the application for a Section 10 permit will likely be denied[75]. In this situation, the Net National Benefits associated with Alternative 3 "collapses" to that associated with the status quo (**Alternative 1**). If, however, a written memorandum can be developed whereby the ACOE will agree to allow siting of marine

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71 An initial review of this document suggested that non-aquaculture vessels transporting through the zones or pipelines or cables being placed there might also be prohibited. Authority granted in the Magnuson-Stevens Act likely does not extend to these types of activities.

72 One caveat to this statement should be made. Specifically, there are likely to be some relatively minor administrative costs associated with these designated areas, even if (a) potential aquaculture establishments eventually develop a facility outside the area and (b) there are no other current users of the designated areas.

73 *Offshore Framework*, p. 73

74 *Offshore Framework*, p. 73

75 There is likely to be an exception to this general finding. If the Council selects Action 7, Alternative 3, there may be instances where the role of the COE is diminished (since no semi-permanent or permanent structures may be required.

aquaculture facilities based on the criteria developed by the Council (and NOAA Fisheries Service), then there would likely to be some benefits associated with the transparency. In particular, time may be saved by both potential investors and management agencies since applications will not be submitted (or could easily be rejected) that do not meet the specified criteria. Having this criteria explicitly stated, furthermore, might reduce costly litigation in instances where applications are denied.

The economic impacts of **Preferred Alternative 4** are expected to be similar to those that would result under **Alternative 3**. Neither alternative would establish marine aquaculture areas and both would establish general siting criteria that would be used in part to determine whether a site was suitable. **Preferred Alternative 4** goes farther, in terms of defining that applications would be applied on a case-by-case basis to provide environmental safeguards and including other agencies siting requirements.

The case-by-case review of the siting application could increase the cost and time of the permitting process. Under **Alternative 3**, a permit could be issued if the firm selected an area that met all the general siting criteria. **Preferred Alternative 4** would require that the proposed site and growing technology are compatible to ensure that negative environmental impacts would be minimized. The amount of additional time required to complete that review will depend on the staff available to conduct the review, the number of siting permits that are under review, and level of controversy surrounding whether that site is appropriate. If the site and growing technology are not controversial and NOAA Fisheries Service staff is available to review the proposal, the cost and time to acquire the permit should be similar to **Alternative 3**. However, it possible that a backlog of permit applications or a marginal site proposal could delay approval by days, weeks, or potentially months. The costs of the delay for the applicant would be the increased time to start production and additional costs that could be incurred debating the permit requirements. NOAA Fisheries Service would incur higher costs if more staff time were required to resolve the application approval or denial. However, the increased costs would not be expected to outweigh the benefits that the Nation would derive from increased environmental safeguards.

Preferred Alternative 4 also explicitly states that the siting criteria would include siting requirements from other agencies that are tasked with overseeing specific activities. The intent of this component is to recognize that other agencies are also involved in the siting process and not to duplicate the requirements of other agencies.

Appendix A in Bridger (2004) provides a summary of work presented by Fletcher and Weston (2004) on the legal and regulatory environment of the offshore aquaculture permitting process. That information is used here to provide a summary of permitting roles of the ACOE, EPA, and MMS.

ACOE permit requirements are a result of the Section 10 of the Lakes and Harbors Act of 1899, as extended by the Outer Continental Shelf Lands Act (OCSLA). A Section 10 permit is required when an obstruction is permanently or temporarily attached to the seabed. The OCSLA extended the ACOE authority into the EEZ by allowing the agency to regulate "installations and other devices permanently attached to the seabed, which may be erected thereon for the purpose of exploring for, developing or producing resources from the outer continental shelf" (Bridger

2004). The ACOE considers several potential impacts before issuing a Section 10 permit. Some of the areas considered are the effects and impacts on water quality, recreation, fish, other wildlife, pollution, safety, aesthetics, navigational integrity, and economic impacts.

The EPA, under Section 318 of the Clean Water Act requires a point source pollution discharge permit for aquaculture projects in the open ocean. Factors considered when reviewing the permit application include the need for proposed dumping and effects on human health and welfare, fisheries resources, plankton, fish, shellfish, wildlife, shorelines, beaches, and the marine ecosystem.

The MMS has jurisdiction, under the Outer Continental Shelf Lands Act, to oversee lease sites that are attached or near an oil or gas platform. MMS requires a permit for platform removal or transfer of ownership.

Because each of the above agencies requires specific information before a permit would be issued, the additional cost of NOAA Fisheries Service requiring similar information would likely be limited to the cost of sending the information to NOAA Fisheries Service. The data would not need to be recreated, so the costs associated with providing the additional data would be the time and copy/printing charges of sending the additional information. If the additional information required 20 pages at $0.10 per page, it would cost $2.00 plus shipping costs and the time to print and mail the information. A reasonable estimate to assemble, print, and mail the information would be about 10-15 minutes for 20 pages.6.7.3

6.7.3 Direct and Indirect Effects on the Administrative Environment

Alternative 1 would require the least administrative effort, because NOAA Fisheries Service would only be commenting on the application for a ACOE permit and not evaluating a proposed site through its own permitting process. If the ACOE allowed a system NOAA Fisheries Service found had unacceptable biological, ecological, or physical effects, negotiation with the ACOE and the applicant to resolve NOAA Fisheries Service's concerns could be time consuming for staff.

Alternative 2 would require the most administrative effort. Under this alternative, the perceived advantage to the applicant in choosing a site in an "allowable aquaculture area" is faster permit review. This expedited review would require NOAA Fisheries Service to evaluate the suitability of large areas for aquaculture before the permit application is ever received, and regardless of whether any permit application is ever received. Even after this evaluation is completed, the applicant could choose to site their aquaculture system in an unevaluated area. In this scenario, NOAA Fisheries Service would assume administrative costs up front for analyses which may not be necessary, in order to attempt to speed up the permit application process for the applicant. NOAA Fisheries Service would be expected to review certain permits faster than others. However, depending on availability of NOAA Fisheries Service staff and that of reviewing staff such as those from the General Counsel's office, this expedited review may not be possible. This situation could result in additional staff time spent interacting with the applicant to resolve complaints. **Alternative 3** and **Preferred Alternative 4** would require more administrative effort than **Alternative 1**, but less than **Alternative 2**. Establishment of site selection criteria for **Alternative 3** and **Preferred Alternative 4** would take staff time when reviewing applications,

but not as much as would evaluation of actual proposed areas which may never be used, as required in **Alternative 2**. **Alternative 1** could result in legal issues and their associated administrative costs if a ACOE-permitted site ultimately caused unacceptable biological, ecological, and/or physical effects and NOAA Fisheries Service found it necessary to stop the operation. Such legal issues would be much less likely if NOAA Fisheries Service were to carry out its own evaluation of the site.

If **Alternative 3** were chosen, NOAA Fisheries Service could require an applicant to provide detailed, site-specific topographic information, water quality data, current information, characterization of existing sediment biota, or other data. The company may need to pay a third party to obtain this information. NOAA Fisheries Service could also ask the applicant to demonstrate the characteristics of a site would not cause negative effects on habitat, water quality or other areas of concern. Such site-specific information and modeling efforts are commonly required when evaluating permits for LNG or oil extraction activities. **Preferred Alternative 4** would have similar requirements for an operation to consider when determining siting of a facility, but it also allows for incorporation of new regulations developed by pother agencies that may arise in reviewing the siting of aquaculture facilities.

6.8 Action 7: Establish Buffer Zones for Marine Aquaculture Facilities

The Council does have authority to create zones that excludes fishing or fishing vessels. Examples are zones where fishing with certain gear is prohibited and no-take zones where fishing and possession of fish is prohibited. Restricting access around aquaculture facilities would afford some protection to an operation's equipment and the product being cultured. On the other hand, limiting usage near these sites could be seen as a user conflict by denying the public from accessing these areas. The most prudent way to overcome this issue is for an aquaculture facility to request a site permit large enough to afford protection from potential user conflict problems (e.g. a vessel accidentally cutting a mooring line while passing the facility), while at the same time maximizing other user groups' access to the open ocean.

6.8.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

Establishing zones around aquaculture facilities is primarily administrative and does not directly affect the physical, biological, or ecological environment. Buffer zones would reduce gear and user conflict, and therefore not affect the physical, ecological, or ecological environment. However, establishing buffer zones may indirectly affect the physical, biological, and ecological environment.

Alternative 2 establishes buffer zones which may incidentally create a small area that functions similar to a Marine Protected Area (MPA). Certain species of fish, marine mammals, and seabirds may congregate to the structures used in aquaculture facilities. If these animals were protected from vessels entering into this area, they would be undisturbed by vessels that may otherwise frequent these structures in targeting wild specimens. If left undisturbed for long periods of time, these sites may become breeding grounds or areas of spawning aggregations.

However, the likelihood of this occurring is unlikely due to the normal day-to-day operations of an aquaculture facility. In order to properly maintain the structures and animals within these structures, frequent visitation and maintenance by aquaculture facility staff will be necessary, thereby disturbing the wild animals that may tend to congregate. Therefore any indirect effects of establishing a buffer zone would be expected to be minimal on the biological, ecological, and physical environment.

6.8.2 Direct and Indirect Effects on the Economic and Social Environment

The Council is considering restricting access around marine aquaculture facilities. There is one alternative (create buffer zones) and the status quo (**Preferred Alternative 1**).

The Council has the authority to create zones that exclude certain persons or activities. Examples are zones where fishing with certain gear is prohibited and no-take zones where fishing and possession of fish is prohibited. Creation of buffer zones for aquaculture facilities (**Alternative 2**) may provide some limited benefits to investors; particularly in terms of liability issues and protection of investment. The buffer zones may also facilitate and strengthen enforcement activities (i.e., being inside the buffer zone may provide the presumption of guilt). The costs associated with creating buffer zones, such as (a) additional dislocation of commercial and recreational fishing activities (b) non-aquaculture vessels transporting through the zone, and (c) pipelines and cables being placed there are expected to be very minor, but are likely to increase in relation to the size of the established buffer zone[76].

The lack of any detailed information on this Action precludes a detailed assessment of economic impacts, one can conclude with some degree of certainty that the Net National Benefits associated with **Alternative 2** will be greater than that under the status quo (**Preferred Alternative 1**) if created buffer zones are reasonable in size[77]. Unreasonably sized buffer zones, however, may result in a loss in Net National Benefits associated with **Alternative 2** relative to the status quo.

The need for buffer zones will depend on the structure of Action 6. If the permit sites provide sufficient protections for the aquaculture firms, setting aside additional space for a buffer zone would not be needed or create any additional benefits for the aquaculture firm and could create additional costs for other sectors.

6.8.3 Direct and Indirect Effects on the Administrative Environment

Preferred Alternative 1 would not have a direct effect on the administrative environment. However, the establishment of buffer zones is primarily administrative and would therefore directly effect this environment. Selecting **Alternative 2** would require demarcation of the boundary area around all permitted aquaculture facilities and enforcement of this boundary area.

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76 One (potential) additional cost discussed in the literature reflects aggregation of fish around the structures. If aggregation is significant, catch per unit effort outside the buffer zone may decrease.
77 In reaching this conclusion, it is implicitly assumed that any site permit would approximate the size of the offshore aquaculture facility and that a zone would expand upon this boundary.

The enforcement of these boundary areas would most likely have the greatest effect on the administrative environment, as at sea enforcement is difficult and expensive.

The creation of a buffer zone would allocate resources, particularly those of law enforcement, away from their primary focus, and could therefore, indirectly affect the administrative environment. For these reasons **Alternative 2** would have more of an effect on the administrative environment than **Preferred Alternative 1**.

6.9 Action 8: Recordkeeping and Reporting

Recordkeeping and reporting requirements are meant to allow both aquaculture facilities and NOAA Fisheries Service to examine the operation and thereby the impacts to the physical, biological, and ecological environments. These reports will act as the check and balance system in the time periods between permit issuance and renewal. By requiring annual reports (at a minimum), managers can assess all aspects of a facility and its operation. These recordkeeping and reporting requirements are intended to mitigate impacts associated with marine aquaculture and alert managers to potential problems. If potential problems arise, these requirements will allow NOAA Fisheries Service to work with a facility to resolve potential problems and environmental impacts, or revoke the facilities permit if problems and impacts persist.

6.9.1 Direct and Indirect Effects on the Physical, Biological, and Ecological Environment

Recordkeeping and reporting are administrative in nature and would have no direct effect on the physical, biological, or ecological environment. However, information contained in recordkeeping and reporting may indirectly affect the physical, biological, and ecological environment as these requirements are designed to monitor the effects a facility has on the physical, biological, and ecological environment. By establishing reporting requirements, the impacts of an aquaculture facility on the physical, biological, and ecological environment can be examined. Where appropriate, additional conditions of an aquaculture's operation could be implemented to mitigate these impacts and therefore, reduce the effects on these environments.

As previously discussed in this Section the environmental impacts and concerns associated with marine aquaculture are largely associated with: 1) Modification of wild stock genetic diversity; 2) transmission of infectious disease to wild stocks; 3) modification of benthic habitat from discharged effluents, such as solids, and dissolved nutrients; 4) escaped fish competing with wild fish; and, 5) entanglement of wildlife with aquaculture structures. Recordkeeping and reporting requirements are designed to monitor these concerns and, where appropriate, implement plans to mitigate any deleterious effects.

Alternative 1 would provide the Regional Administrator authority to specify EFP recordkeeping and reporting requirements, but only if Action 1, Alternative 1 (Exempted Fishing Permit) is selected as the preferred alternative. Because Action 1, **Alternative 2** was selected by the Council as the preferred (NOAA Fisheries Service permit to operate a facility), only **Alternative 2** can be selected. The greatest impacts to the biological and physical environments would have occurred if the Council did not select a preferred alternative for Action 8. By not selecting a preferred alternative, aquaculture operations would not have to meet recordkeeping and reporting

requirements. There would be no checks and balances system to monitor environmental impacts. This could negatively affect the physical and biological environments by degrading habitat, spreading disease, and allowing fish escapement.

Instead, **Preferred Alternative 2** will require aquaculture facilities to meet the 10 recordkeeping and reporting requirements. These requirements include various reporting requirements, such as notifying NOAA Fisheries Service of escapement, disease outbreaks, and entanglements. These reporting requirements would also benefit enforcement, by providing them with information on when fish are harvested and landed and requiring facilities to maintain harvest and sale records. Facilities would be required to provide NOAA Fisheries Service with an annual report each year addressing all of the reporting requirements listed in **Preferred Alternatives 2(a-i)**. Overall, **Preferred Alternative 2** would provide NOAA Fisheries Service with sufficient information to monitor and assess the impacts of an aquaculture facility when determining compliance with permit conditions. **Preferred Alternative 2** would help mitigate any environmental impacts by alerting NOAA Fisheries Service to potential problems that can then be resolved.

Establishing reporting requirements as is done with **Preferred Alternative 2** for: Major escapement and reasons for escapement, where major escapement is defined as cumulative escapement of 10 percent or more of stocked fish; a reportable disease outbreak; entanglements or interactions with marine mammals, migratory birds, and endangered species; keeping copies of feed labels on file for three years from date of use; the impacts of an aquaculture facility on the ecological environment can be examined. Where appropriate, additional conditions of an aquaculture's operation could be implemented to mitigate these impacts and therefore, reduce the effects on the ecological environment.

Additionally, reporting requirements established in **Preferred Alternative 2** which inform NOAA Fisheries Service of all species being cultured or notify NOAA Fisheries Service of any changes in sources used for providing fingerlings, could be used to assess the effects on the biological environment. Likewise, requiring a facility to inform NOAA Fisheries Service when the type of aquaculture system used for culture is changed could allow an evaluation of the effects on the physical environment. This requirement could even avoid adverse effects prior to deployment of the system, if the system is known to be deleterious to the physical environment.

Any reporting requirements of an aquaculture's operation could indirectly affect the physical, biological, and ecological environment. A standardized list, as presented in **Preferred Alternative 2**, therefore, would be more beneficial than **Alternative 1** because it allows for comparison between facilities and their effects on the physical, biological, and ecological environments.

6.9.2 Direct and Indirect Effects on the Economic and Social Environment

Recordkeeping and reporting requirements are being considered to enable NOAA Fisheries Service to monitor the activities and impacts of the offshore aquaculture industry. Adding these requirements will tend to increase costs for the industry and the agency collecting the data, but the benefits of collecting that information are assumed to outweigh those costs. The actual costs will likely vary by business.

Two alternatives are being considered that would define the recordkeeping and reporting requirements that must be met by persons operating an aquaculture business in the Gulf EEZ. **Alternative 1** would maintain the status quo where the reporting requirements are those needed for an EFP. **Preferred Alternative 2** would create a suite of recordkeeping and reporting requirements specific to aquaculture firms

The National Aquaculture Act of 1980 as amended was reauthorized in 1998. Language in the Act directs the Secretary of Commerce to collect and analyze scientific, technical, legal, and economic information relating to aquaculture, including acreages, water use, production, marketing, culture techniques, and other relevant matters. Guidance from the National Aquaculture Act of 1980 indicates that relevant physical, biological, and economic information should be collected from aquaculture facilities. Proprietary information submitted to the Secretary is considered confidential and may only be disclosed if required under court order. But, the Secretary may release or make public any information in summary form that does not directly or indirectly disclose the identity, business transactions, or trade secrets of any person who submits the required information.

Costs incurred by Federal agencies and the industry as a result of selecting the status quo are expected to be small for an offshore aquaculture firm and would summarize information in their business plan. The costs to submit the EFP[78] were likely a small part of the overall cost a business would have incurred to develop their business plan, meet all the regulatory requirements, and starting production. Recall that cost estimates of an initial fixed investment of $2.89 million and annual operating capital of $1.28 million (Posadas 2003) were presented for what may be considered a feasible sized operation. If 1 percent was allocated to permit applications it would be about $30,000, this is likely more than the costs required to summarize information, likely in the business plan that is required for an EFP.

The Council could implement any or all of the options above. **Preferred Alternatives 2(f)** and **2(g)** do not require the firm to report information to NOAA Fisheries Service. Those options require the firm to retain information on the feed that was used by the firm and the harvest and sales records of the firm. The conditions under which NOAA Fisheries Service or NOAA GC could access those records are not defined in this action. The cost of maintaining the feed labels would include the labor cost associated with collecting and filing the labels and the cost of file cabinets or other devices used to store the labels for the required three years. Other costs could

78 The Regional Administrator or Director may attach terms and conditions to the EFP consistent with the purpose of the exempted fishing, including, but not limited to: (A) The maximum amount of each regulated species that can be harvested and landed during the term of the EFP, (B) The number, size(s), name(s), and identification number(s) of the vessel(s) authorized to conduct fishing activities under the EFP. (C) The time(s) and places where exempted fishing may be conducted. (D) The type, size, and amount of gear that may be used by each vessel operated under the EFP. (E) The condition that observers, a vessel monitoring system, or other electronic equipment be carried on board vessels operated under an EFP, and any necessary conditions, such as predeployment notification requirements. (F) Reasonable data reporting requirements. (G) Other conditions as may be necessary to assure compliance with the purposes of the EFP, consistent with the objectives of the FMP and other applicable law. (H) Provisions for public release of data obtained under the EFP that are consistent with NOAA confidentiality of statistics procedures at (*sic*) set out in subpart E. An applicant may be required to waive the right to confidentiality of information gathered while conducting exempted fishing as a condition of an EFP.

be incurred if the firm was required to submit the labels or summaries of the labels to NOAA Fisheries Service. Sales receipts should be generated when product is sold. Keeping copies of that information would be considered a reasonable practice for most businesses. Similar information would likely be required for tax and other purposes, so implementing the requirement should not create additional costs.

The firms would be required to report specific information to NOAA Fisheries Service under each of the other options. **Preferred Alternative 2(a)** requires the firm to supply copies of permits and monitoring reports that are generated for other agencies. Those reports would need to be submitted when they are initially generated or modified. The cost of submitting those reports would be the cost of obtaining a copy of the original report (or making copies) and the labor costs associated with obtaining the reports and mailing them to the agency. Those costs are expected to be minimal since no additional time is needed to create the actual information contained in the report.

Preferred Alternative 2(b) would require the firm to submit a report for all fish harvested or landed from their facility. The information would likely be submitted on a form (paper or electronic) that would be generated by NOAA Fisheries Service that is similar to commercial trip tickets. Those forms typically request information on the business, where the fish were harvested, the species harvested, and the method of harvest. Depending on when the report is generated, it could also contain information on the fish buyer or processor and economic information on revenues, costs, or employment. The cost of submitting this information would be similar to that incurred by commercial harvesters or processors when they submit trip ticket or logbook reports. The frequency of the submissions would depend on the number of times a firm harvests their stock, since a report must be submitted every time fish are harvested. The number of reports annually would vary by business and would depend on the species, the size of their facility, and the markets they have developed for their products.

The remainder of the options would trigger the submission of information to NOAA Fisheries Service under specified conditions and a report would need to be submitted every time the condition is met. **Alternatives 2(c)** and **2(d)** would mandate that the firms provide NOAA Fisheries Service with information when a disease outbreak, escapement, or entanglements occur. The cost of submitting the report is not expected to be time consuming or costly, but the information being made available to NOAA Fisheries Service could be very valuable. Some organizations and people are concerned that aquaculture firms are using a public resource to operate their businesses, and that those businesses could impact the wild stocks of fish in the Gulf. It is very important that the NOAA Fisheries Service and the general public be informed of activities that occur at those facilities that could impact the overall health of the ecosystem.

Preferred Alternatives 2(f) and **2(g)** would require aquaculture firms to retain feed labels and harvest and sale records for three years. The requested information would be used for enforcement and monitoring. **Preferred Alternatives 2(e)**, **2(h)**, and **2(i)** would require the aquaculture firm to report information relative to changes in business practices. Each of the options relates to information that would be required on the firms permit application(s). The requested information would be used to update permits. If the changes to the firm are minor, NOAA Fisheries Service could use the information to amend a current permit. If the changes are considered major departures from the original permit, then the firm would likely be required to

submit a new permit application so the entire operation could be reviewed. Applying for a new permit(s) would be more costly than providing a simple notice of change in the operation of the business.

Preferred Alternative 2(j) would require the firm to submit an annual standardized report that would be developed by NOAA Fisheries Service to summarize the information requested in **Alternatives 2(a-i)**. The information requested would be an annual report on the activities of the firm that were already required. The additional report will require time to complete, but since NOAA Fisheries Service will develop the required questions and provide them on standardized form the firm should be able to collect and organize the required data throughout the year. The time requirements should be no greater than the 1-hour required to submit an EFP.

NOAA Fisheries Service will also incur costs developing the data collection instruments, collecting the data, and storing the data. The form should be relatively easy to develop given the types of information being requested. The time that is required to store the data would depend on how NOAA Fisheries Service uses the information. If the data are stored in an electronic format, NOAA Fisheries Service could produce summarized data on the activities of the industry. Those reports could be made available to the general public in an aggregate non-confidential format to provide information on how well the industry is performing in terms of production and environmental impacts.

Requiring the aquaculture firms to provide more information will increase their costs (even if the increases are modest). The increased costs will reduce producer surplus. However, the reduction in producer surplus is justified because it provides the NOAA Fisheries Service and other interested members of society information that allows them to make informed decisions regarding the private use of public resources.

The following are the types of conditions that may be required before an offshore aquaculture permit(s) would be issued to the applicant. The permit conditions are designed to ensure that NOAA Fisheries Service can identify and contact captains and owners of the facility, determine the location of the pens/facility, collect the costs of removing the facility, and enforce commercial fishing regulations. All of the permit conditions could increase costs of operating the aquaculture firm. However, the costs associated with many of the provisions would be minimal.

The only options that would increase the costs beyond the typical paperwork requirements when applying for a permit are **Preferred Alternatives 2(c)**, **2(d)**, **2(e)**, and **2(i)**. **Preferred Alternative 2(k)** would provide the NOAA Fisheries Service RA authority to specify additional permit conditions, as necessary, for issuance, review, and administration of an aquaculture permit. Because the additional permit conditions are unknown at this time, social and economic impacts cannot be assessed. Any permit conditions imposed are likely to strengthen environmental safeguards and therefore result in positive benefits to the Nation and public. However, these additional requirements may increase costs to operations.

6.9.3 Direct and Indirect Effects on the Administrative Environment

Record keeping and reporting is an administrative function and would directly effect this environment. The administrative environment of both the aquaculture facility in maintaining and submitting these records, as well as the administrative environment of NOAA fisheries, in the review process would be affected by the requirement to maintain records. However, the use of records and reports is designed to monitor impacts associated with aquaculture operations, which may reduce long-term burdens on the administrative environment. Detecting problems with an operation and taking action to halt those negative practices before they become hazardous to the environment or have irreversible impacts will have less of an impact to the administrative environment than waiting for the permit renewal stage to discover these problems. Although recordkeeping and reporting is a burdensome and directly affects the administrative environment, **Preferred Alternative 2** is more beneficial than **Alternative 1** because of the trade-off between long-term and short-term impacts and burden.

6.10 Comparison of Alternatives to Magnuson-Stevens Fishery Conservation and Management Act National Standards

NOAA General Counsel has concluded that aquaculture in the EEZ constitutes "fishing" under the MSFCMA. Any FMP or regulations prepared to implement an FMP or amendment, must be consistent with the ten MSFCMA national standards for fishery conservation and management. These national standards are:

1. Conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimum yield from each fishery for the United States fishing industry.
2. Conservation and management measures shall be based upon the best scientific information available.
3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.
4. Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.
5. Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.
6. Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.
7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.
8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing

communities by utilizing economic and social data that meet the requirements of paragraph (2), in order to (A) provide for the sustained participation of such communities, and (B) to the extent possible, minimize adverse economic impacts on such communities.

9. Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.
10. Conservation and management measures shall, to the extent possible, promote the safety of human life.

The development of an aquaculture program requires balancing the potential benefits of aquaculture to the nation's economy and food supply while maintaining the quality of the marine environment. The effects of the actions and preferred alternatives in this amendment as they relate to the MSFCMA and the National Standards are discussed below.

National Standard 1

This National Standard requires conservation and management measures to prevent overfishing while achieving, on a continuing basis, the OY from the fishery (16 U.S.C. § 1851(a)(1)). Though separate issues, the prevention of overfishing and the achievement of OY are related. In effect, the most important limitations on the specification of OY are that management measures designed to achieve it must also prevent overfishing. "Overfishing" is defined in the MSFCMA as a level or rate of fishing mortality that jeopardizes the capacity of a fishery to produce MSY on a continuing basis (16 U.S.C § 1802(3)(29)).

The Council has developed objective and measurable definitions for determining if most of the stocks allowed for aquaculture (see Section 4.4) are overfished or undergoing overfishing as required by the National Standard Guidelines (50 CFR § 600.310(d)(2)). Consistent with the National Standard Guidelines, the Council has instituted programs to rebuild the stocks overfished or subject to overfishing.

The primary goal of federal fishery management, as described in National Standard 1 of the MSFMCA, is to conserve and manage U.S. fisheries to "...prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry". OY is defined as the amount of fish that provides the greatest net benefits to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems. While economic and social factors are to be considered in defining the OY of each fishery, OY may not exceed MSY, or the maximum amount of fish that can be removed without impairing the fishery's ability to replace removals through natural growth or replenishment. OY must prevent overfishing and, in the case of an overfished fishery, must provide for rebuilding stock biomass to a level consistent with that which would produce MSY.

The MSY and OY of each Council-managed fishery are currently limited by the fishery's biological potential. However, adding an aquaculture component to Council-managed fisheries would increase the total yields these fisheries could produce to the amount of fish harvested from wild stocks plus those fish produced by aquaculture operations. Increasing the seafood

production potential of these fisheries will increase their contributions to national, regional, and local economies, and their capacity to meet the Nation's nutritional needs.

In addition to increasing OY, aquaculture may also help reduce fishing mortality on Council and HMS managed stocks by providing an alternate source of food in place of overfished wild stocks and stocks undergoing overfishing. Aquaculture may also allow enhancement of populations. For example, EEZ aquaculture programs could be used to raise and release species that are overfished or subject to overfishing in order to boost the abundance and status of a stock. Such a program could enhance traditional rebuilding programs being carried out by reducing fishing mortality. Additionally, increased supply from domestic aquaculture could relieve pressure on wild stocks.

National Standard 2

National Standard 2 requires conservation and management measures to be based on the best scientific information available (16 U.S.C § 1851(a)(2)). The analytical work and data sources queried in developing this amendment were extensive. This analytical work relied on the most current economic, social, and biological information available at the time of the analysis. Data and analysis sources are given in the References Cited in Section 10. Prior to approval of this amendment, the Southeast Fisheries Science Center will make a determination if this amendment is based on the best scientific information available. The preferred alternatives summarized in Sections 4.3 and 4.8 would enhance data collection, therefore assisting the Council and NOAA Fisheries Service in identifying and utilizing the best scientific information available when developing subsequent NEPA analyses and amendments. Lastly, as stated in the purpose and need, additional environmental analyses may be required if future proposed aquaculture operations fall outside the scope of this amendment and EIS. This will allow NOAA Fisheries Service and the Council the opportunity to incorporate the best scientific information available to address items not within the scope of this document.

National Standard 3

This standard requires an individual stock of fish to be managed, to the extent practicable, as a single unit throughout its range, and interrelated stocks of fish to be managed as a unit or in close coordination (16 U.S.C § 1851(a)(3)). Action 4, Preferred Alternative 4 would only allow species native to the Gulf of Mexico that are not genetically modified. Species used for aquaculture would either be managed by the GMFMC or by NOAA Fisheries Service Highly Migratory Species Division. This amendment considers the entire range of each stock proposed for aquaculture under the management jurisdiction of the GMFMC and NOAA Fisheries Service and therefore complies with National Standard 3.

National Standard 4

Under National Standard 4, conservation and management measures shall not discriminate between residents of different states (16 U.S.C § 1851(a)(4)). Discrimination is defined as differentiating among people or corporations based on their state of residency. Fishery management plans must not rely on or incorporate a discriminatory state statute (50 CFR § 600.325(b)). Allocation is defined as direct and deliberate distribution of the opportunity to

participate in a fishery among identifiable, discrete user groups or individuals (50 CFR § 600.325(c)(1)). To be consistent with the "fairness and equity" criterion, an allocation should be rationally connected with the achievement of OY or with the furtherance of a legitimate FMP objective (50 CFR § 600.325(c)(3)(i)(A)). Otherwise, inherent advantage of one group to the detriment of another would be without cause. In addition, an allocation of fishing privileges may impose hardships on one group if they are outweighed by the total benefits received by another group (50 CFR § 600.325(c)(3)(i)(B)).

Persons who are granted permits for an aquaculture facility will be those who demonstrate they can comply with the permit conditions and requirements stated in this amendment and subsequent regulations. This amendment does not consider actions or alternatives that would discriminate between residents of different states, nor does it assign fishing privileges associated with the permitting process. Criteria used to assess where an aquaculture facility is sited will be considered on a case-by-case basis and do not discriminate among permittees or aquaculture operations based on their proposed location of operation.

National Standard 5

This standard requires conservation and management measures to promote efficiency in the use of fishery resources, where practicable, except that no such measure will have economic allocation as its sole purpose (16 U.S.C § 1851(a)(5)). The National Standard Guidelines recognize that, theoretically, an efficient fishery would harvest the OY with the minimum use of economic inputs such as labor, capital, interest, and fuel (50 CFR § 600.300(b)(2)). Hence, an efficient management regime conserves all resources, not just fish stocks.

It is anticipated that the culture processes will be carried out efficiently, especially the feeding process. Aquaculture operations will require large investments of capital and financial resources. Each operation will function as a private business with profits depending on productivity and marketability of cultured products minus costs. If an operation does not function efficiently, then it will not be profitable. With the exception of operations conducting stock enhancement, cultured products will increase the OY for a fishery, resulting in greater net benefits to the Nation and promoting efficient use of fishery resources. Additionally, actions and alternatives considered in this amendment are intended to prevent or mitigate to the extent practicable environmental impacts on wild fisheries. These measures are considered necessary for promoting environmental efficiency when operating aquaculture facilities and will allow managers to assess an operation's compliance with regulatory requirements.

National Standard 6

National Standard 6 requires management measures allow for variations among, and contingencies in, fisheries, fishery resources, and catches (16 U.S.C § 1851(a)(6)). Variations, uncertainties, and unforeseen circumstances can be experienced in the form of biological or environmental changes, or social, technological, and economic changes. Flexibility of a management regime is necessary to respond to such contingencies (50 CFR § 600.335(b) and (c)).

Several actions and preferred alternatives in this amendment provide for flexibility in the management regime. These include actions 5 and 6, which allow for NOAA Fisheries Service to evaluate siting criteria and allowable marine aquaculture systems on a case-by-case basis. By allowing case-by-case review, technological changes and new biological and environmental information on the impacts of marine aquaculture can be accounted for and addressed. Additionally, the numerous reporting and recordkeeping requirements required in Actions 3 and 8 allow for unforeseen circumstances to be accounted for and addressed. These unforeseen circumstances include, but are not limited to: storm damage, escapement, disease outbreaks, and entanglements of wildlife.

National Standard 7

This National Standard requires management measures to minimize costs and avoid unnecessary duplication (16 U.S.C § 1851(a)(7)). Management measures should not impose unnecessary burdens on the economy, individuals, organizations, or governments (50 CFR § 600.340(c)).

The RIR indicates the aquaculture programs would initially increase annual administrative and enforcement costs. Actions 3 and 8 require extensive recordkeeping and reporting requirements to be met. Costs associated with meeting these requirements will be incurred by both aquaculture operations and NOAA Fisheries Service. Additionally, costs to enforcement may be increased since the regulations proposed in this amendment constitute new regulations to monitor and enforce. These additional costs are believed to be necessary, and have been minimized to the extent practicable, to ensure environmental impacts are prevented or mitigated,

When possible and to the extent practicable, the Council and NOAA Fisheries Service have attempted to avoid duplication of paperwork requirements. Aquaculture or regulations affecting aquaculture fall under the jurisdiction of multiple federal agencies, each with distinct jurisdictions. This amendment acknowledges the role of each of these agencies in the permitting and monitoring process and does not attempt to impose overlapping requirements on aquaculture permit applicants. The authority of each federal agency is discussed briefly in Sections 5.4 and 9.0. With the exception of Action 6, no actions in this amendment would duplicate requirements of these federal agencies. Action 6 will require NOAA Fisheries Service to evaluate siting criteria for a marine aquaculture facility taking into account existing laws and regulations imposed by other federal agencies, such as the ACOE, EPA, and MMS. The ACOE has authority to issue a siting permit for an aquaculture facility. However, through passage of this amendment NOAA Fisheries Service would also be given authority to evaluate siting criteria for aquaculture facilities. Although the criteria used for assessing the adequacy of an aquaculture site may differ between these agencies, there still remains potential for multiple reviews of an aquaculture site. Lastly, both Actions 3 and 8 refer to permits and environmental standards required by other agencies, such as the EPA. The information required for these actions is intended to assist NOAA Fisheries Service in determining compliance with and issuance of aquaculture permits and is not believed to be duplicative since similar standards and permits will not be required by NOAA Fisheries Service.

National Standard 8

This National Standard provides that conservation and management measures shall, consistent

with the conservation requirements of the MSFCMA (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities (16 U.S.C § 1851(a)(8)).

Gulf of Mexico fishing communities potentially affected by this action are listed in the Generic Essential Fish Habitat Amendment EIS (GMFMC 2004 and GMFMC 2005). Impacts to fishing communities are also discussed in Sections 4, 6, 7, and 8 of this amendment. It is unknown at this time whether aquaculture will directly compete with landings from domestic fisheries. If aquaculture does compete with domestically landed wild fisheries, then there is potential for impacts on fishing communities to occur (loss of jobs, loss of revenue due to decreased prices). However, because foreign imports represent a significant amount of the current U.S. seafood, it is not expected that domestically cultured species will significantly impact fishing communities over the short term. Over the long-term economic benefits may accrue to those communities providing support to aquaculture ventures, which may have some negative ramifications on fishing communities relying on wild stocks.

National Standard 9

The MSFCMA requires fishery management plans establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery (16 U.S.C. §1853(a)(11)). National Standard 9 requires conservation and management measures, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch (16 U.S.C. §1851(a)(9)).

Actions 3 and 5 are the only actions considered in this amendment that are expected to affect bycatch. Action 3, Alternative 3(b)(iii) requires aquaculture operations to specify the number and size of broodstock they propose to capture and the gears used for capture. It is expected that only a small number of fish (sufficient to satisfy genetic diversity requirements) will be captured each year by aquaculture operations. Although bycatch may occur during the capture of broodstock, the amount of bycatch is expected to be small and negligible relative to overall bycatch occurring in each fishery.

Action 5 specifies allowable marine aquaculture systems. The type of system used for aquaculture may incidentally create bycatch of fish, sea turtles, and other protected resources. Bycatch could occur if a species becomes trapped or entangled in an aquaculture system, such as a cage. To minimize bycatch to the extent practicable, NOAA Fisheries Service will review and approve aquaculture systems on a case-by-case basis. Those systems that pose a significant entanglement risk to endangered and threatened species, sea birds, and other marine species would not likely be permitted. Upon receiving an operational permit, aquaculture operations would be required to report entanglements and mortalities (see Section 4.8).

National Standard 10

This national standard provides that, conservation measures shall, to the extent practicable, promote the safety of human life at sea (16 U.S.C § 1851(a)(10)).

All offshore aquaculture facilities must comply with the private aids to navigation (33 C.F.R. 66.01) and the vessel safety requirements of the U.S. Coast Guard. The ACOE permitting process will apply to the offshore facilities constructed by permit applicants. That includes review of the construction characteristics of the facility. Additionally, Action 3 requires aquaculture operations to describe emergency disaster plans, which should assist operations in improving safety-at-sea during natural disasters.

6.11 Mitigation Measures

Regulations for implementing the National Environmental Policy Act (NEPA) require environmental impact statements include appropriate mitigation measures not already included in the proposed action or alternatives (40 CFR 1502.14(f) and 1502.15(h)). The preferred alternatives in this generic amendment would allow commercial aquaculture in the Gulf of Mexico. The impacts of allowing aquaculture are described in detail for each action in Sections 4, 6, and 7. Each action and its subsequent alternatives propose measures to mitigate the impacts of allowing aquaculture. No additional measures are proposed to mitigate the impacts of aquaculture. The following discussion summarizes the mitigation measures proposed in each action.

6.11.1 Action 1: Types of aquaculture permits required

This action considers whether or not to develop a permitting system for offshore aquaculture in the Gulf of Mexico. **Alternative 1** would require an EFP and would likely continue to constrain development of commercial aquaculture in the EEZ. **Preferred Alternative 2** and **Alternative 3** would require either a single operating permit (**Alternative 2**) or an operating and siting permit (**Alternative 3)** to conduct aquaculture. In order to obtain permit(s) under either **Alternative 2** or **3**, applicants must also meet various permit conditions summarized in Action 3. Review of applications for these permits would likely require more administrative effort to review than would an EFP, because this amendment would require many additional requirements than are currently required under an EFP. These permit requirements will also likely cost the applicant more than would an EFP, although applicants would no longer be required to develop extensive environmental assessments for their proposed project. These administrative costs and costs to the applicant are mitigated by the positive effects on the administrative, physical, and biological environments which would result from such a thorough evaluation of a permit before it was issued.

6.11.2 Action 2: Duration of the permit

The duration of permit issuance is primarily an economic consideration, although it could have ramifications to the physical and biological environments if a permit is not regularly reviewed for compliance with governing regulations. Actions 3 and 8 in this amendment require operations comply with several permit conditions, recordkeeping requirements, and reporting requirements. These requirements and conditions will alert NOAA Fisheries Service of potential problems occurring at a facility and provide them with a basis for either revoking a permit or requiring a facility to change its business practices in order to prevent unacceptable impacts to the biological, physical, and/or ecological environments. If, at any time, permit conditions or

recordkeeping and reporting requirements are not being met, NOAA Fisheries could initiate an on-site inspection to determine the operations impact and, if needed, suspend or revoke the operation's permit prior to its expiration.

Alternative 2(d) would allow for the longest permit duration (indefinite) and therefore be most beneficial to aquaculture operations seeking to obtain financial backing. **Alternative 1** would provide the shortest permit duration (1 year with a possibility of renewel) and would likely continue to constrain commercial aquaculture production from developing in the Gulf of Mexico. **Alternatives 2(a-c)** provide intermediate permit durations ranging from 5 to 20 years. Although the 10-year preferred permit duration would provide less financial benefits (more difficult to obtain financing and less desirable to investors) than longer permit durations, the negative effects of this alternative are believed to be mitigated by the benefits of more frequent permit review.

6.11.3 Action 3: Permit conditions

Alternative 1 would not specify permit conditions for aquaculture operations. **Alternative 2** would maintain the same permit conditions as required by an EFP, while **Alternative 3** would require applicants obtain an assurance bond and submit various plans for operating and monitoring aquaculture activities. Requirements under **Preferred Alternative 3** are the most comprehensive and would require the most time for the applicant to prepare and the agency to review. **Preferred Alternative 3** would also cost the applicant substantially more because the company would be required to obtain an assurance bond for permit issuance. The negative administrative and economic effects to the applicant and NOAA Fisheries Service are mitigated by the positive effects on the administrative, physical, and biological environments resulting from completion of a permit with such conditions and the assurance that aquaculture structures will be removed in the event an operation terminates.

Other permit conditions, including requirements for environmental monitoring, may be required by other agencies, such as the EPA. These monitoring requirements are intended to assess the impacts of an aquaculture operation and if necessary correct potential problems. Water quality monitoring requirements would be specified by the EPA and may require operations to met pre-defined water quality standards.

6.11.4 Action 4: Species allowed for aquaculture

Alternative 1, which would not preclude culture of exotic species or the culture of genetically modified native species in the Gulf of Mexico EEZ, could have negative effects on the administrative, biological, physical, and ecological environments as described in Section 6.5 unless such introductions were based on a scientific risk analysis. **Alternatives 2, 3,** and **4** would not allow aquaculture of exotic species and differ from each other only in the particular native species which could be cultured. Alternative 4 would allow for the culture of all marine species in the Gulf of Mexcio managed by the Council with the exception of shrimp species and coral species (there currently exists a separate permitting system for live rock) and would request that NOAA Fisheries Service develop concurrent rulemaking to allow aquaculture of highly migratory species. Any negative economic effects to the applicant from limiting the number of species that could be cultured would be mitigated by the positive effects of keeping non-native and/or genetically modified species out of the Gulf in the event of escapement.

In addition to those species allowed for aquaculture, non-target species may be affected by aquaculture activities. These species could include protected resources and non-target fishes used for fishmeal. Impacts to protected species would be mitigated through ESA consultations (see Section 5.4.1.1). ESA statutes and regulations prohibit the take, import or export, possession, sale, delivery, or transport of all endangered species and most threatened species. Impacts to non-target species, such as menhaden, will be mitigated by potential adjustments to management measures following periodic stock assessments.

6.11.5 Action 5: Allowable marine aquaculture systems

Alternative 1 would not specify allowable aquaculture systems, and would not provide for NOAA Fisheries Service to specifically evaluate proposed systems. **Alternatives 2** and **3** would allow applicants to use cages, net pens, and/or invertebrate aquaculture systems. **Preferred Alternative 4**, would allow for case-by-case review of each aquaculture system and could limit what systems applicants could use. However, unlike **Alternatives 2** and **3**, this alternative would allow for technological innovations that may provide added protection to the physical and biological environments. The negative effect of limiting the type of system an applicant could use would be mitigated by the positive benefits to the administrative, biological, physical, and ecological environment of allowing only robust systems to be deployed in the Gulf of Mexico EEZ. Additionally, Alternative 4 would mitigate negative effects to applicants by allowing future designs of aquaculture systems that have greater structural integrity. The more reliable the system, the less risk the applicant would incur if it is damaged or causes environmental damage. Recall that an applicant would be required to possess an assurance bond as a condition of permit issuance. Currently, it is not clear what authority NOAA Fisheries Service has for requiring an assurance bond and specifying conditions for such a bond.

6.11.6 Action 6: Designation of sites or areas for aquaculture

Alternative 1 would rely on NOAA Fisheries Service's review of site permits issued by the Corps of Engineers to evaluate proposed aquaculture sites. **Alternatives 2-4** would provide NOAA Fisheries Service with authority to evaluate a proposed aquaculture site, rather than relying solely on the review and comment procedures of another agency (**Alternative 1**). This would allow NOAA Fisheries Service to disapprove aquaculture sites proposed for aquaculture, which may have been previously approved by the ACOE. **Alternative 2** would allow establishment of pre-authorized aquaculture areas, while **Alternatives 3** and **4** establish siting criteria for marine aquaculture facilities. **Alternatives 2-4** may duplicate to an extent the ACOE's siting requirements, but this duplication is expected to mitigate potential environmental impacts to the physical and biological environments since NOAA Fisheries Service and the ACOE have different authorities and criteria for siting a facility. Additionally, **Preferred Alternative 4** will involve case-by-case review for siting. Although this is expected to increase the amount of time needed to review a permit application relative to **Alternatives 2** or **3**, this inconvenience to the applicant and increased administrative costs to the government is mitigated by the site-specific evaluation allowed.

6.11.7 Action 7: Establish buffer zones for marine aquaculture facilities

Alternative 2 would establish buffer zones around marine aquaculture facilities where fishing activities are prohibited, while **Preferred Alternative 1** would not establish such zones. The economic burden to fishermen of being excluded from these zones could be substantial. Some fishermen may view buffer zones as a form of marine protected area, where fishing is prohibited. It is well known that many fish aggregate around structures, and the aquaculture systems could attract fish from outside such a zone and keep fishermen from catching them. These negative economic effects are not mitigated by any positive biological and socioeconomic benefits associated with establishing a buffer zone, therefore **Alternative 1** is preferred.

6.11.8 Action 8: Recordkeeping and reporting

Keeping records and making reports to NOAA Fisheries Service and other federal agencies, as described in **Alternative 2,** could be seen as an administrative burden to aquaculture companies. **Alternative 1**, which would not require such recordkeeping and reporting, would not incur such a burden. However, if such records were not kept and reports were not made, problems with an aquaculture facility could result in negative effects to the administrative, economic, biological, physical, and biological environments and go undetected and unresolved. Therefore, the benefits of preventing these negative effects mitigate any administrative and economic burdens suffered by the aquaculture companies.

6.12 Cumulative Effects Analysis

NEPA mandates federal agencies assess not only the indirect and direct impacts associated with regulatory actions, but also the cumulative impacts associated with those actions. NEPA defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 C.F.R. 1508.7). Cumulative effects can either be additive or synergistic. A synergistic effect is when the combined effects are greater than the sum of the individual effects.

This following CEA is based upon guidance offered in CEQ (1997). The report outlines 11 items for consideration in drafting a CEA for a proposed action. These items include:

1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.
2. Establish the geographic scope of the analysis.
3. Establish the timeframe for the analysis.
4. Identify the other actions affecting the resources, ecosystems, and human communities of concern.
5. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stress.
6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds.
7. Define a baseline condition for the resources, ecosystems, and human communities.

8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.
9. Determine the magnitude and significance of cumulative effects.
10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.
11. Monitor the cumulative effects of the selected alternative and adapt management.

The CEA for the biophysical environment will follow these 11 steps. Cumulative effects on the biophysical environment and the socio-economic environment will be analyzed separately.

1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.

The CEQ cumulative effects guidance states this step is accomplished through three activities. The three activities are as follows:

I. The direct and indirect effects of the proposed actions.

Direct and indirect effects of the proposed actions are summarized in Sections 6.2 through 6.9.

II. Which resources, ecosystems, and human communities are affected?

The resources, ecosystems, and human communities affected by this action are described in Section 5.0. These include:

1. Managed resources (allowable aquaculture species)
2. Non-target fisheries (menhaden and other fishes potentially used for feed)
3. Habitat, including essential fish habitat
4. Protected resources
5. Gulf of Mexico fishing communities

III. Which effects are important from a cumulative effects perspective?

The effects most important from a cumulative effects perspective are described in this CEA.

2. Establish the geographic scope of the analysis.

The immediate areas affecting managed resources, non-target fisheries, habitat, and protected resources are waters of the Gulf of Mexico, including both state and federal waters.

Most species managed by the Council are distributed in waters off the Yucatan, throughout the Gulf, to the waters off North Carolina. Some species, such as mackerel or cobia, migrate throughout this range seasonally, while others, such as gray triggerfish, have higher site fidelity. Highly migratory species, such as tunas, and various protected species occur throughout the world including waters of the Gulf. Most species have pelagic larvae, thus, some exchange of fish between regions could occur. However, larval movement patterns are not well understood. Within the Gulf, genetic and life history data suggests multiple stocks of the same species may exist (e.g. mackerel and red snapper).

Aquaculture products are currently sold worldwide and products ultimately produced in the Gulf of Mexico will likely be sold in markets similar to those where wild caught products are sold. Therefore markets both around and outside the Gulf are expected to purchase and sell aquaculture products. However, most if not all aquaculture species would be landed in the Gulf and therefore would primarily affect local fishing communities. The immediate areas affecting humans would include fishing communities primarily along the Gulf of Mexico coast and to a lesser extent the South Atlantic coast. Although offshore aquaculture operations would only be sited in the Gulf of Mexico, many species managed by the Gulf Council occur in the South Atlantic. Production of cultured fish may therefore affect those South Atlantic fishing communities that harvest wild species that are also cultured in the Gulf of Mexico.

3. Establish the timeframe for the analysis.

Section 2.2 describes the history of management for aquaculture nationally and in the Gulf. A national policy on aquaculture was first approved in 1980 through the passage of the National Aquaculture Act (NAA). The NAA was reauthorized in 1985 and subsequent legislative bills were proposed for Congressional consideration in 2005 and 2007. In the Gulf, the first offshore finfish aquaculture operation was an experimental operation in Texas state waters in the late 1980s and early 1990s. The first applicant to propose an offshore finfish aquaculture operation in federal waters of the Gulf was Seafish Mariculture L.L.C., which received an EFP from NOAA Fisheries Service in October 1997 to culture red drum, greater amberjack, and red snapper. This aquaculture project was later terminated in July 1999. To date, Seafish Mariculture is the only business that has successfully received an EFP for aquaculture in federal waters of the Gulf of Mexico, although several other businesses have made inquires to NOAA Fisheries on how to apply for an EFP.

The timeframe for the CEA should take into account both historical efforts to establish regional and national aquaculture programs, as well as future considerations if this amendment and its subsequent regulations are approved and implemented by NOAA Fisheries Service. The timeframe for the CEA begins in 1980, with the passage of the NAA, and extends through 2018, which is ten years after this amendment would first be approved and implemented. The end of the CEA also corresponds to the preferred duration of aquaculture permits as described in Action 2.

4. Identify the other actions affecting the resources, ecosystems, and human communities of concern.

This generic amendment proposes to amend five of the Council's seven FMPs. Only the FMP for Corals and the Shrimp FMP would not be amended. Regulations that alter the allowable harvest of the species managed under these FMPs may alter the characteristics and operations of aquaculture facilities. When reduction in harvest of wild caught species occurs, a positive economic effect on the aquacultured conspecifics would be expected, while conversely, increases in the wild caught fishery would be expected to create a depressed value of aquaculture conspecifics. However, it is difficult to say with certainty if these trends would hold true for all species, some, or even none.

Other actions that affect aquaculture are those regulations which would be imposed and subsequently altered by other agencies with regulatory authority in the EEZ under various laws or existing authority. The EPA may affect aquaculture facilities by altering or imposing water quality parameters for offshore aquaculture under Section 318 of the Federal Water Pollution Control. The EPA must also approve chemicals and pesticides used in open ocean aquaculture. Additionally, FDA regulations may affect an aquaculture facilities' ability to use various chemicals or therapeutics for pest and/or disease control, as well as allowable levels of those agents for human consumption.

Similarly, the U.S. Army Corps of Engineers, through authority of Section 10 of the Rivers and Harbors Act of 1899, can affect aquaculture facilities by their review of the siting of such facilities in navigable waterways. Under the authorities of the Fish and Wildlife Coordination Act, the Endangered Species Act of 1973, the Migratory Bird Treaty Act, and the Marine Mammal Protection Act of 1972, the USFWS may review and comment on any project authorized, licensed or funded by the federal government with respect to effects on fish and wildlife. Finally, the USCG has authority to require aquaculture-related structures be marked with appropriate lights and signals.

Natural disasters and economic change can also affect resources, ecosystems, and communities. Such events include diseases outbreaks, red tides, changes in economic conditions, foreign imports, high fuel prices, hurricanes and storm events, and hypoxia. These disasters and economic changes can negatively affect the profits of aquaculture operations and fishermen. They can also damage existing infrastructure and reduce resource availability. However, aquaculture operations, unlike wild fisheries, will function as private businesses with successes and failures determined largely by business plans and the resilience of the operation to the above events. Compliance with the actions and alternatives proposed in this amendment will allow for environmentally sound and sustainable aquaculture. However, additional stresses could be placed on wild fisheries if operations impact the environment as described in Section 6.1. To prevent or minimize impacts from aquaculture, the alternatives proposed herein are intended to mitigate environmental and socio-economic impacts. Mitigation measures are described in detail in Section 6.11.

5. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stress.

This step should identify the trends, existing conditions, and the ability to withstand stresses of the environmental components. According to the CEQ guidance describing stress factors, there are two types of information needed. The first are the socioeconomic driving variables identifying the types, distribution, and intensity of key social and economic activities within the region. The second are the indicators of stress on specific resources, ecosystems, and communities.

CEA factor #4 above describes the various stresses affecting the resources, ecosystems, and human communities of concern. Fishermen face numerous economic stresses. These manifest themselves as either additional cost to fishing, or from reducing ex-vessel prices for harvested fish. Added costs include increases in such items as fuel, ice, food, and insurance. Factors reducing ex-vessel prices for fishermen include market gluts, increases in imported fish, or fish

health issues. Changes in revenue and increased operating costs are two indicators of socioeconomic stress. In recent years, the additional stresses of overfishing, hurricanes, and fuel prices have resulted in marginal profits and losses in revenue forcing many fishermen to leave fisheries and seek more stable sources of employment. Fishermen targeting healthier stocks and with lower expenses are more resilient to the stresses described above. In contrast those fishermen relying on stocks that are frequently subject to overfishing and stringent management regulations, or that have greater expenses relative to other fishermen, are less resilient to various stresses making them more likely to seek other jobs. Because aquaculture operators would only rely on a small number of broodstock from wild stocks, they are more likely to be resilient to stresses such as overfishing of wild stocks. However, other stresses may affect aquaculture operations such as the ability to economically compete with wild caught fish, environmental factors which may diminish culture productivity (e.g., red tide, changes in temperature or dissolved oxygen), storm events, and large up-front financial investments.

Indicators of stress to the biological environment include reductions in population abundance and habitat degradation. As mentioned above, the Council and NOAA Fisheries Service evaluate the status of wild stocks relative to various pre-defined benchmarks and implement necessary management measures to maintain sustainable resources. The susceptibility to stress depends on a species productivity and life history. In general, longer lived, slower-growing species, such as many reef fishes, are more susceptible to stresses (overfishing, becoming overfished), then shorter-lived, more fecund species. As a result, the time to rebuild these populations is often much longer and reductions in harvest are much greater. For aquaculture operations, a species life history will affect the potential success of an operation and how profitable it may be. Faster growing species that are less susceptible to disease and command higher market prices will provide the fewest stresses to aquaculture operations. Similar, the location of a facility will be a critical aspect to its success or failure. For instance, facilities located in areas where hurricanes are more likely to occur or where current conditions are less optimal may incur more stresses due to lower production and potential for facility damage then facilities not located in these areas.

Wild stocks are another resource that could be potentially impacted by aquaculture operations through escapement of fish or disease outbreaks. Additionally, non-target species, such as menhaden, could be negatively affected if demand increases for fish meal. The stresses placed on wild stocks and their resilience to these stresses are largely contingent on wild fishery regulatory restrictions and the environmental regulations imposed on facilities. This amendment proposes numerous measures intended to mitigate impacts on the biological, physical, and ecological environments (see Section 6.11). All of these measures are intended to reduce stresses on wild stocks by preventing or minimizing escapement, disease, entanglements, and habitat degradation. The status of wild stocks, both managed and non-target species, is regularly monitored through both state and federal stock assessments. These stock assessments allow managers to adapt to changes in fishing practices and adjust management to conserve natural resources. As a result, any stresses resulting from aquaculture on wild stocks above and beyond those stresses by domestic fisheries will be addresses through adjustments in Council fishery management plans and federal/state regulations.

6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds.

This section examines whether resources, ecosystems, and human communities are approaching conditions where additional stresses could have an important cumulative effect beyond any current plan, regulatory, or sustainability threshold (CEQ 1997). Sustainability thresholds can be identified for some resources, which are levels of impact beyond which the resources cannot be sustained in a stable state. Other thresholds are established through numerical standards, qualitative standards, or management goals. The CEA should address whether thresholds could be exceeded because of the contribution of the proposed action to other cumulative activities affecting resources.

The MSFCMA requires federal fishery management plans to prevent overfishing and achieve optimum yield on a continuing basis. For many Council and HMS managed stocks, status determination criteria and benchmarks have been established to evaluate the status of a stock or stock complex. Currently, four species in the Gulf of Mexico are undergoing overfishing (gag, gray triggerfish, red snapper, and greater amberjack). Red snapper and greater amberjack are overfished, and gray triggerfish will be declared overfished once the Council approves an overfished threshold in Amendment 30A. The remainder of Council managed species are either healthy or their status is unknown. There are nine HMS species that are overfished and nine that are undergoing overfishing. Many of these species are not likely to be cultured, such as billfishes and sharks. Thirteen ESA-listed species are known to occur in the Gulf of Mexico and six species are considered candidates for listing as endangered or threatened. Several non-target species, such as menhaden, which are not managed by the Gulf Council may be affected by this action.

Stresses affecting each of these resources include directed fishing mortality, habitat loss and degradation, increasing demand for food and feed, and environmental changes (e.g., red tide, hurricanes, changes in temperature, etc.). The status of many of these species is regularly assessed through periodic assessments and their status is determined relative to pre-defined criteria. The status of Gulf fish stocks, endangered and threatened species, and highly migratory species is summarized in Section 5.0 relative to pre-defined benchmarks. When fisheries are determined to be overfishing or overfished, NOAA Fisheries Service and/or the Councils are required by the Magnuson-Act to implement conservation and management measures to prevent overfishing and rebuild overfished stocks. States and interstate compacts may also impose regulations to control fishing mortality and harvest. The recent reauthorization of the Magnuson-Act requires Councils and NOAA Fisheries Service to establish annual catch limits and accountability measures to end overfishing of all stocks by either 2010 or 2011. For endangered and threatened species, the ESA prohibits take, import or export, shipment, or sale of any endangered species and most threatened species.

Stresses affecting fishing communities include additional regulatory restrictions, competition from foreign seafood imports, coastal development, loss of infrastructure, and rising fuel prices. All of these stresses have placed a greater burden on fishermen and fishing communities that threaten their short- and long-term sustainability. In the past three years, the Council has implemented numerous regulations to end overfishing of several reef fishes. The Council has also approved several rebuilding plans to increase stock biomass and abundance of reef fishes. These regulations have resulted in lower allowable catch levels, more restrictive trip limits, and limited access. Although the net benefit of these regulations is expected to result in more abundant and stable fisheries in the long-term, they have the unavoidable adverse effect of

negatively affecting profits and value in the short-term. As a result, the cumulative effect of more restrictive regulations, coastal development, higher fuel prices, and natural disasters has led many fishermen to leave the industry in recent years and seek more stable forms of employment.

Developing an environmentally sound and sustainable aquaculture program is intended to alleviate some of these stresses. To the extent that development of an aquaculture industry may cause additional stresses (e.g., escape of cultured fish, nutrient loading, etc), the Council's preferred alternatives in this amendment are intended to minimize these stresses to the extent practicable (see Section 6.11 Mitigation Measures). The environmental permitting, reporting, recordkeeping and siting conditions associated with the proposed aquaculture program are consistent with the Council policy to encourage environmentally responsible marine aquaculture. These conditions are intended to ensure the operations of all offshore aquaculture facilities permitted in the Gulf of Mexico are consistent with the MSFCMA National Standards (Section 6.10) and do not compromise Council objectives for wild fisheries. As discussed in Section 3 (Purpose and Need), open ocean aquaculture will assist NOAA Fisheries Service and the Council in optimizing yield above levels achieved solely from wild stocks, providing the greatest net benefit to the Nation with respect to food production, while taking into account necessary environmental protections needed to sustain Council and NOAA Fisheries Service managed fisheries native to the Gulf of Mexico. Aquaculture has the potential to increase yield to levels much greater than current MSY and OY estimates for Gulf fisheries. In addition to increasing OY, aquaculture may also help reduce fishing mortality on Council and HMS managed stocks by providing an alternate source of food instead of overfished wild stocks and stocks undergoing overfishing. Aquaculture may also provide additional job opportunities for local fishing communities, especially those fishing communities most affected by federal and state management restrictions.

7. Define a baseline condition for the resources, ecosystems, and human communities.

The purpose of defining a baseline condition for the resource and ecosystems in the area of the proposed action is to establish a point of reference for evaluating the extent and significance of expected cumulative effects.

The status of Council managed resources are summarized in the annual status report to Congress on the Status of U.S. Fisheries (NMFS 2006). The baseline status of Council managed species is also described in section 5.0 of this amendment. Gag, gray triggerfish, red snapper, and greater amberjack are undergoing overfishing in the Gulf, red snapper and greater amberjack are overfished, and gray triggerfish will be declared overfished once the Council approves an overfished threshold in Amendment 30A. The remainder of Council managed species are either healthy or their status is unknown. There are nine HMS species that are overfished and nine that are undergoing overfishing. Many of these species are not likely to be cultured, such as billfishes and sharks. Additionally many ESA-listed species or candidate species for ESA-listing are known to occur in the Gulf (see Section 5.2.3.3).

The status and health of EFH is extensively described in GMFMC 2004 and GMFMC 2005. The Council, NOAA Fisheries Service, and other federal agencies have designated numerous areas in the Gulf of Mexico to protect and conserve EFH. These areas protect EFH from a wide variety of direct impacts, including: loss of fishing gear, restricted use of certain fishing gears, and

damage from anchors. Section 5.1 in this amendment describes numerous environmentally sensitive areas where aquaculture could be restricted. In addition, Action 6 will require NOAA Fisheries Service conduct case-by-case reviews of aquaculture sites. The EPA already imposes monitoring requirements for NPDES permits to collect baseline data. Baseline data for a site, and plans for monitoring environmental impacts will also be required by NOAA Fisheries Service to evaluate localized changes to the benthos, water column, and biological environment.

Section 5.3.3 describes baseline conditions for fishing communities throughout the Gulf. The Generic Essential Fish Habitat Amendment (GMFMC 2004) provides more extensive characterization of fishing-dependent communities throughout the Gulf coasts. The communities that will be affected as a result of developing offshore aquaculture in the Gulf are difficult to project at this time. There is no information available that describes where firms will have their headquarters, where their supplies will be purchased, where employees will be hired or live, where the offshore facilities will be located, or how social conditions will change.

8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.

Cause-and-effect relationships for various aspects of offshore marine aquaculture and measures proposed in this amendment to address these potential effects are summarized in Table 6.12-1.

Table 6.12-1. The cause-and-effect relationship of aquaculture activities and proposed regulatory actions.

Cause	Potential Effect	Measures to Address Potential Effects
non-native species	competition with native species, loss of biodiversity, economic damage, transmit disease, degrade habitat	prohibit use of species not native to the Gulf - Action 4
genetic modification	changes in wild population genetic structure if fish escape	prohibit use of genetically modified species for aquaculture - Action 4
improper siting	habitat degradation, reduced water quality, increased entanglements of wildlife, user conflicts, navigational hazard, decreased water quality	case-by-case review when siting a facility - Action 6; compliance with ACOE, EPA, and USCG permitting requirements
reduced water quality	reduced biological and ecological productivity, increased risk of infectious disease	case-by-case review when siting a facility by NOAA Fisheries Service - Action 6; compliance with EPA standards - Action 3
improper aquaculture system construction	increased entanglement and injuries of wildlife; habitat degradation	case-by-case review when permitting allowable aquaculture systems - Action 5
abandoned equipment	habitat degradation, navigational hazards	require assurance bond for structure removal - Action 3
permit duration	too long - increased potential for	annual reporting and recordkeeping

Cause	Potential Effect	Measures to Address Potential Effects
	environmental impacts not being discovered; too short - problems with procuring capital	requirements - Action 8; permit conditions - Action 3; periodic on-site visits by NOAA Fisheries Service staff; EPA monitoring standards
escapement	genetic modification and competition with native, wild stocks	required plans for addressing escapement and maintaining genetic diversity - Action 3; Use of native, non-genetically modified stocks - Action 4; Notification of escapement - Action 8
speculative entry	large number of permits issued; permittees have no intent of using permits	use-it or lose-it requirement - Action 3
allowing offshore aquaculture	potential loss or increase in jobs to local communities, increased risks of localized environmental impacts, poaching of wild fish, competing uses	review social and economic data over time as the aquaculture industry develops; regular monitoring and permit conditions - Actions 3 and 8; appropriate siting - Action 6

9. Determine the magnitude and significance of cumulative effects.

It is difficult to predict the magnitude and significance of cumulative effects at this time, because it is unknown how many aquaculture operations will apply for permits in the near future. The following discusses the magnitude and significance of cumulative effects relative to past, present, and reasonably foreseeable future actions. For purposes of discussion, cumulative effects are discussed in the context of Action 1 (permit or do not permit a regional aquaculture program).

Past actions affecting aquaculture are described in Section 2.2. Since 1980, the U.S. has had a national aquaculture policy. However, to date there have been only limited offshore aquaculture operations; most of which have occurred in state and not federal waters. In the Gulf of Mexico, the current permitting framework (EFPs) is not conducive to the development of an aquaculture industry. Additionally, the U.S. is increasingly importing a larger share of seafood to meet domestic demand. Allowing a regional aquaculture program to develop will increase the supply of domestic seafood, while minimizing or preventing environmental impacts on wild fisheries, habitat, and water quality. Although not allowing a regional permitting program to develop would provide the least risk to the biological and social/economic environments, actions considered in this amendment are intended to mitigate such impacts. Under a best-case scenario, numerous aquaculture operations would be permitted in the Gulf. These operations would have environmentally sound aquaculture systems, pose minimal or no impacts to localized water quality and wildlife, be sited in areas that prevent or significantly reduce the likelihood of habitat degradation and user conflicts, and culture large amounts of native, non-genetically modified fish from the Gulf of Mexico helping to reducing fishing pressure on wild stocks and increase OY . In order to accomplish this best case scenario, the Council has selected numerous preferred alternatives in this amendment to mitigate or prevent negative environmental effects. These are described in greater detail in Section 6.11. The worst-case scenario would occur if potential effects in Table 6.12-1 occur. However, the Council and NOAA Fisheries Service have

proposed numerous monitoring, recordkeeping, and reporting requirements to ensure these potential effects are prevented, or in some cases, minimized to the extent practicable.

Presently, there are no proposed aquaculture operations applying for EFPs in the Gulf, although at least three firms have inquired about obtaining an EFP in the last few years. National aquaculture legislation is now currently being proposed in Congress. A 2005 bill came under criticism because of the perceived lack of environmental safeguards. A bill resubmitted to Congress in 2007 is intended to address at least some of these criticisms; however, it is unknown when this legislation may be passed. Even if the bill is approved this year, it is expected to take several years to implement a national aquaculture program. The bill, as proposed, would exempt aquaculture from the definition of "fishing" and provide for consultations with fishery management councils. This legislation would potentially override the actions proposed in this amendment; however, it is unknown whether or not proposed national legislation would have greater or less environmental standards and requirements than those proposed in this amendment.

Other actions presently being considered by the Council and NOAA Fisheries Service that will be reasonably implemented in the foreseeable future include: 1) measures to end overfishing of red snapper (Amendment 27/14 to the Reef Fish and Shrimp FMPs), 2) modifications to shrimp trawl bycatch reduction device criteria, 3) measures to address overfishing of gag, gray triggerfish, and greater amberjack (Amendments 30A and 30B to the Reef Fish FMP), and 4) measures to increase red grouper TAC (Amendment 30B to the Reef Fish FMP). The Council is also developing a scoping document for a grouper limited access privilege program and may begin work on an amendment in 2008 to allocate reef fish landings. A majority of the above mentioned amendments are intended to reduce mortality on wild stocks and rebuild overfished fisheries. These actions will have negative effects on fishermen and fishing communities in the short-term, with positive benefits accruing as stocks rebuild. Additionally, the MSFCMA will require the Council and NOAA Fisheries Service to implement annual catch limits and accountability measures for most managed stocks by 2010 or 2011. Annual catch limits and accountability measures are intended to prevent or greatly reduce the risk of overfishing and are expected to have positive biological benefits. However, they will also likely impose more restrictive catch levels on many fisheries resulting in negative social and economic impacts over the short-term. To the extent that catch limits and accountability measures can prevent overfishing and assist in rebuilding overfished stocks, they should have positive long-term benefits to both the biological and socio-economic environments.

As discussed in Section 6.10, aquaculture is expected to assist the Council in achieving the objectives of its FMPs, including optimizing yield and potentially reducing overfishing. Open-ocean aquaculture will allow yield to be optimized at levels above those achieved solely by wild stocks, providing the greatest net benefit to the Nation with respect to food production, while taking into account necessary environmental protections needed to sustain Council and NOAA Fisheries Service (i.e., highly migratory species) managed fisheries native to the Gulf of Mexico. In addition to increasing OY, aquaculture may also help reduce fishing mortality on Council and HMS managed stocks by providing an alternate source of food instead of overfished wild stocks and stocks undergoing overfishing. The amendment includes several recordkeeping and reporting requirements to prevent or mitigate impacts to habitat and protected resources (see Sections 4.3, 4.6, and 4.8). Additionally, for non-target species, such as menhaden, assessments will be conducted periodically to determine if wild stocks are being managed at sustainable

levels. If offshore aquaculture results in increased demand for fishmeal from species such as menhaden than states and interstate compacts may need to impose more restrictive regulations to protect these wild-prey species. Fishing mortality and abundance for these species, as well as managed species, will be determined periodically by assessments and established targets and thresholds.

10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.

The cumulative effects of developing a regional aquaculture permitting system on the socioeconomic environment are expected to be positive, although some negative social and biological impacts may result if aquaculture is not conducted in an environmentally sustainable manner. To prevent or minimize impacts associated with aquaculture, the actions and alternatives in this amendment include various measures to mitigate impacts. Such measures include:

- Action 3: Requiring aquaculture permit holders to obtain an assurance bond for removal of structures if an operation terminates.
- Action 4: Do not allow non-native or genetically modified species to be used for aquaculture in the Gulf.
- Action 5: Evaluate proposed aquaculture system on a case-by-case basis to ensure reliable offshore growing system technology is used to provide environmental safeguards.
- Action 6: Establish siting criteria to be applied on a case-by-case basis to ensure reliable offshore growing system technology is used to provide environmental safeguards.
- Action 8: Require the following recordkeeping and reporting requirements:
    - Provide NOAA Fisheries Service with state, EPA, and ACOE monitoring reports.
    - Report disease outbreaks, escapement, and entanglements of marine mammals, protected species, and migratory birds.
    - Maintain harvest and sale records and feed labels for three years.
    - Obtain prior approval before culturing new species.
    - Submit an annual standardized report describing requirements in Action 8, Alternative 2(a-i).

In addition to these measures, NOAA Fisheries Service staff will conduct site visits at facilities to ensure aquaculture facilities are operating properly and not causing unacceptable impacts to the biological or ecological environments. If, at any time, permit conditions or recordkeeping and reporting requirements are not being met, NOAA Fisheries could initiate an on-site inspection to determine the operations impact and, if needed, revoke the operation's permit prior to its expiration.

For non-target species that may be indirectly affected by this action (e.g., menhaden used as fishmeal for aquaculture), stock assessments will be conducted periodically to determine if stocks are being managed at sustainable levels. If non-target stocks are not being managed at sustainable levels, states or interstate compacts may impose regulations to reduce fishing mortality, constrain harvest and rebuild overfished stocks.

Socioeconomic impacts will depend largely on whether or not cultured products supplant domestic, wild caught fish in the marketplace and displace fishing communities (e.g., job losses/increases, price competition). Currently, foreign imports represent a majority of seafood consumed in the U.S. Domestic aquaculture will increase the supply of fresh U.S. fish. However, the extent to which cultured fish will compete with domestic, wild fisheries is unknown at this time. If cultured fish supplant wild harvest, than fishing communities reliant on the harvest of wild fish may be negatively affected. Alternatively, if aquaculture increases job opportunities for local fishing communities, then net economic and social benefits may result. Until socioeconomic impacts of domestic aquaculture are better understood, there is no way to mitigate potential future impacts.

11. Monitor the cumulative effects of the selected alternatives and adapt management.

The effects of the proposed actions will be monitored through the submission of management plans and periodic reports to NOAA Fisheries Service and other agencies, such as the EPA. Action 3 requires aquaculture permit applicants describe plans for: maintaining genetic diversity, managing aquatic animal health, collecting broodstock and rearing fingerlings, and conducting environmental monitoring. Additionally, Action 8 requires permit holders to maintain various records and submit various reports to NOAA Fisheries Service regarding issues ranging from disease outbreaks to entanglement of protected resources. This information, as well as water quality data provided to the EPA, will allow NOAA Fisheries Service and other federal agencies to monitor the cumulative effects of the preferred alternatives and make management adjustments, as necessary.

6.13 Unavoidable Adverse Effects

Administrative Costs

Implementing and administering a permitting program for aquaculture will result in additional unavoidable costs to federal agencies, particularly NOAA Fisheries Service Southeast Region. Although NOAA Fisheries Service Southeast Region currently issues EFPs, only one EFP has been issued to an aquaculture operation in the last 10 years and only two other EFPs have been considered for issuance. The numerous permit requirements, records, and reports will require additional workload for NOAA Fisheries Service staff. Costs to other federal agencies, such as the ACOE, EPA, and USCG, may also increase because of additional review and administration to issue siting, pollution discharge, and navigational permits.

Loss of Fishing Grounds

The development of offshore aquaculture will require the production facility to have access to the portion of the ocean where they operate. The exclusive use of an area means that the offshore aquaculture firms will compete for space in federal waters with other activities, such as recreational and commercial fishing. Conflicts between aquaculture firms and commercial or recreational fishers could arise if the aquaculture site is a desirable fishing area or if the site attracts fish (see Section 6.1.5.1). Action 6 establishes siting criteria by which NOAA Fisheries Service will evaluate a proposed aquaculture site. To the extent practicable, historical and important fishing grounds will be taken into consideration when approving or disapproving a particular facilities location. However, in some instances the loss of fishing areas may be

unavoidable given the numerous other siting criteria that will be considered by NOAA Fisheries Service and the ACOE.

While empirical evidence is sparse, available information suggests that loss of fishing areas may be very limited. As discussed in the Sustainable Marine Aquaculture Task Force report (2007), three offshore facilities are currently operating in Hawaii. These three operations lease a total of 193 acres which equates to an average of 64 acres per operation. If future operations in the Gulf are of a similar size to those currently operating in Hawaii, one can conclude that the amount of open space occupied by these structures will be exceedingly small relative to the total available area; even with a large number of operations.

Localized Water Quality and Benthic Changes

Section 6.1.3 discusses the effects of effluents from marine aquaculture facilities. Although the effects of aquaculture operations in the deep water environment are significantly fewer than those near-shore, impacts still exist and are unavoidable. Impacts are primarily related to two factors: 1) increased organic loading on the benthos, and 2) nutrient enrichment of the water column. The EPA regulates water quality through NPDES permits, while NOAA Fisheries Service has authority to protect and conserve EFH. Action 3 will require aquaculture applicants to submit plans for monitoring impacts in compliance with EPA standards. Additionally, NOAA Fisheries Service will use siting criteria to avoid placing aquaculture facilities in areas of critical and essential fish habitat. However, because aquaculture and in particular cage culture will involve feeding and maintaining fish in a contained area, localized small-scale impacts to water quality and benthos are unavoidable and mitigated to the extent possible.

Exclusive Use of a Public Resource

During public comment periods throughout the development of this amendment numerous constituents voiced concerns about providing aquaculture operations exclusionary use of public resources. Siting and permitting in this amendment will afford aquaculture operations the privilege to conduct aquaculture at a specified site in the Gulf of Mexico EEZ. However, siting of a facility will be contingent on ACOE and NOAA Fisheries Service review. An operation would be provide use of a particular site for the duration of their permit, unless revoked before it expires or is renewed. Although an aquaculture operation may occupy both the water column and benthos at a particular site within the EEZ, the operation would not be provided ownership of the site, nor would they be leasing the site. With regard to biological resources, wild stock used for aquaculture would have to be accounted for when managing commercial quotas, TACs, and pending annual catch limits. The number or amount of fish used for aquaculture would be contingent on NOAA Fisheries Service approval and depend on several factors, including an operation's plan for managing genetic diversity.

Fishing Communities

It is not well-known whether aquaculture will positively or negatively benefit fishing communities. Positive impacts could include a localized influx of business and increased jobs, while negative impacts could include increased price competition with wild-caught fish and loss of domestic fishing jobs. The severity and direction of the impact will to some extent depend on the species cultured and the location of an aquaculture facility relative to a fishing community. Unavoidable adverse impacts to fishing communities will therefore occur if in fact aquaculture operations depress wild-caught fish prices and create competition for fishing-industry jobs.

As noted in the Sustainable Marine Aquaculture Task Force report (2007), "[a] large question looming as we begin to farm the sea is how will it transform coastal communities? Fitting into coastal communities will be a major challenge for the marine aquaculture industry as it expands into new areas and interacts with a variety of stakeholders. Coastal communities in many areas suitable for aquaculture have traditionally depended on fisheries and have, in recent decades, increasingly depended on tourism. The jobs and revenue that aquaculture brings have been welcomed in some coastal communtities, including some hit hard by the decline in wild fisheries. Others, however, have rejected aquaculture development (p. 22)."79 However, it is difficult to identify those communtites along the Gulf coast which would "welcome" offshore aquaculture and which communities would oppose it without an in-depth social analysis of the individual communities and their perceptions regarding offshore aquaculture. As noted in the Marine Aquaculture Task Force report (2007), one reason for opposition to located in nearshore waters reflects visual impact concerns. Given that net pens and cages are likely to be submerged and out of site of land, opposition due to aesthetic concerns may be relatively minor. The report also suggests that competition for space with other uses (e.g., recreational boating and fishing) has also generated opposition. Given the relatively limited amount of ocean space that will likely be required for even a sizeable number of these facilities, however, calls into question the amount of opposition that would likely to be forthcoming if an offshore aquaculture industry is developed.

6.14 Relationship Between Short-term Uses and Long-term Productivity

Developing a successful, environmentally sound aquaculture industry will allow optimum yield and long-term productivity to increase over time. Increasing the domestic supply of seafood will assist in alleviating the seafood import deficit while providing the U.S. with a safer, sustainable supply of seafood. Additionally, as discussed in Section 6.10, potential benefits of developing an aquaculture permit program over the long term could include decreased pressure on wild fish stocks and increased opportunities for employment in Gulf coast communities. Because an aquaculture industry currently does not exist in the Gulf, short-term uses will largely stem from the creation of profitable aquaculture operations. Initial financial investments for offshore aquaculture operations are often substantial and require many years before an operation is profitable and there is a return on one's investment. If an operation can succeed financially over the short-term, then the social and economic environments will benefit from the long-term productivity of sustainably-produced aquaculture products that comply with stringent federal environmental standards.

6.15 Irreversible and Irretrievable Commitments of Resources

Freeman (1992) defines irreversible commitments as "those that cannot be reversed, except perhaps in the long term." These would include such instances where ore was removed from a mine or a species went extinct. Irretrievable commitments are "those that are lost for a period of time" such as when the right-of-way of a road running through a forest is lost from timber production.

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79 In general, the discussion provided in the Sustainable Marine Aquaculure Task Force report (2007) is assumeed to relate observations of nearshore facilities (given the fact that there are few offshore facilities).

Alternatives and actions in this amendment are largely intended to prevent irreversible commitments. Measures include preventing non-native, transgenic species from being used for aquaculture, case-by-case review of aquaculture systems and siting criteria, and various recordkeeping and reporting requirements. Irreversible commitments that could potentially result from aquaculture include habitat damage or degradation if aquaculture structures are damaged or destroyed during storm events. In the event of escapement, native, non-genetically modified cultured species are expected to prevent negative biological and ecological impacts to wild stocks. An irretrievable commitment resulting from aquaculture would be the temporary loss of fishing grounds where an aquaculture facility is sited Fishing grounds would be lost for the period of time the permit is issued. However, siting criteria will assist NOAA Fisheries Service in identifying sites that minimize losses of important fishing grounds and other habitat.

6.16 Any Other Disclosures

CEQ guidance on environmental consequences (40 CFR §1502.16) indicates the following elements should be considered for the scientific and analytic basis for comparisons of alternatives. These are:

a) Direct effects and their significance.
b) Indirect effects and their significance.
c) Possible conflicts between the proposed action and the objectives of federal, regional, state, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned.
d) The environmental effects of alternatives including the proposed action.
e) Energy requirements and conservation potential of various alternatives and mitigation measures.
f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.
g) Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures.
h) Means to mitigate adverse environmental impacts.

Items a, b, d, e, f, and h are addressed in Sections 4, 5, and 6.1-6.11. The other elements are not applicable to the actions taken in this document. Because this amendment concerns the management of a marine fish stock, it is not in conflict with the objectives of federal, regional, state, or local land use plans, policies, and controls (Item f). However, it should be noted the goals of this amendment are to establish a regional permitting process for environmentally sound aquaculture. These are goals the Council shares with NOAA Fisheries Service and the Department of Commerce.

Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures (Item g) is not a factor in this amendment. The actions taken in this amendment will affect a marine stock and it's fishery, and should not affect land-based, urban environments.

6.17 Evaluation of Significance Factors

NOAA's Administrative Order 216-6 (NAO 216-6) contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality regulations at 40 C.F.R. 1508.27 contain criteria for determining the significance of the impacts of a proposed action. CEQ regulations state that the significance of an action should be analyzed both in terms of "context" and "intensity." The significance of this action was analyzed based on criteria contained in both CEQ regulations and NOAA's Administrative Order 216-6. Where relevant, specific sections pertaining to each factor are identified below. These sections provide a more thorough discussion of each significance factor.

1) *Can the proposed action be expected to have a substantial impact on biodiversity or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?*

Discussion: Allowing the development of a marine aquaculture industry in the Gulf of Mexico is not expected to impact biodiversity or ecosystem function. Aquaculture operations would be allowed to take only a limited amount of wild fish for use as broodstock. The amount taken would likely pail in comparison to recreational and commercial fisheries harvest, and therefore would have no or little effect on ecosystem function. Requiring only native, non-genetically modified species to be cultured would provide an environmental safeguard in the event of escapement. Non-indigenous species or genetically modified species have been shown to compete with wild stocks, thereby affecting ecosystem function and predator-prey relationships. Additionally, localized affects around a marine aquaculture facility may occur. Studies have shown changes in nutrients, benthic diversity, and predators immediately surrounding open ocean net pens and cages (see Section 6.1). Although this may result in localized changes in biodiversity and predator-prey relationships, changes on a Gulf-wide scale are unlikely to be significant.

2) *Can the proposed action be reasonably expected to have a substantial adverse impact on public health and safety?*

Discussion: Currently, the U.S. imports 75 to 80 percent or more of its seafood. Imports are largely from foreign countries with less restrictive environmental standards than the U.S. This amendment is expected to benefit public health by allowing the development of an environmentally sound aquaculture program in the Gulf of Mexico. Specific actions related to aquaculture in this amendment intended to increase public health and safety include: allowing only structurally sound and stable aquaculture systems (Action 5), case-by-case review of aquaculture facility sites (Action 6), prohibiting the use of non-native species for aquaculture (Action 4), and requiring extensive plans for managing animal health, genetic diversity, and disasters (Action 3).

3) *Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?*

Discussion: Section 5.0 describes the physical, biological, social, economic, and administrative environments affected by this action, including important fishery resources, critical habitat, threatened and endangered species, and Gulf fishing communities. Unique characteristics of the geographic area where an aquaculture facility will be sited will be evaluated on a case-by-case basis by NOAA Fisheries Service using various criteria identified in this amendment and by other federal agencies. One of the unique characteristics of the Gulf of Mexico geographic area is the predominance of oil and gas platforms (~4,000) that could be used for infrastructure of offshore aquaculture operations.

4) *Are the effects on the quality of the human environment likely to be controversial?*

Discussion: Allowing the development of a regional aquaculture permitting system is likely to be highly controversial. National aquaculture legislation proposed in 2005 was scrutinized in part because of concerns about adequate environmental safeguards. Commercial fishermen have expressed concerns that aquaculture products will increase competition and potentially reduce their profits. Concerns have also been expressed about impacts to water quality, the loss of fishing grounds, and habitat degradation.

5) *Are the effects on the human environment likely to be uncertain or involve unique or unknown risks?*

Discussion: Sections 6 and 7 discuss the possible effects of aquaculture on the human environment. To date, most offshore aquaculture operations have been small-scale research or pilot projects primarily occurring in state waters. Although effects on the human environment are well-known for projects of this magnitude, the effects of potentially permitting numerous large scale operations are less known. In many places in this amendment/PDEIS, the authors have acknowledged whether or not the possible effects of this action on the human environment are known. One benefit of this amendment is that it will require recordkeeping and reporting requirements that will allow for the possible effects of this action to be better understood in the future. Because many effects are not well understood, the Council has elected to choose alternatives which mitigate these potential negative effects on the human environment (see Section 6.10).

6) *Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?*

Discussion: The proposed action would set a precedent if implemented before national legislation is approved by Congress. The U.S. has had a policy on marine aquaculture since 1980, but a sustainable, economically viable aquaculture industry in the U.S. has yet to develop. This action, if implemented, would become the first U.S. permitting program for offshore marine aquaculture. In doing so, the actions and preferred alternatives in this amendment would set the first standards for regulating aquaculture in federal waters and protecting the marine environment from any potential adverse effects.

7) *Are the proposed actions related to other actions with individually insignificant but cumulatively significant impacts.*

Discussion: The cumulative effects analysis (see Section 6.12) provides a detailed description of the relationship of this action with past, present, and reasonably foreseeable future actions. This action is not related to any other actions that are individually insignificant but with cumulatively significant impacts.

8) *Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historical Places or cause loss or destruction of significant scientific, cultural, or historical resources.*

Response: No. This action affects only federal waters, and would not affect any historic or cultural resources listed in the National Register of Historical Places. Mitigation measures proposed in this amendment, such as case-by-case review of aquaculture systems (Action 5) and facility locations (Action 6), is intended to prevent or minimize loss or destruction of resources.

9) *Can the proposed action reasonably be expected to adversely affect an endangered or threatened species, marine mammals, or critical habitat of these species?*

Discussion: Sections 5.2.3.3 and 6.1.4 discuss the potential adverse impacts on endangered and threatened species. The proposed action will alter the manner in which the fishery operates. Wild fisheries are primarily caught by hook-and-line or longlines, although traps, spears, and nets can be used for some species. The deployment of aquaculture systems will represent a new type of gear used in the Gulf. Additionally, aquaculture operations may be proposed in migration pathways or areas of important habitat for threatened or endangered species. Biological reviews/consultations will be conducted when necessary by the NOAA Fisheries Service Southeast Regional Office Protected Resources Division to ensure aquaculture systems and facility locations proposed for aquaculture will not adversely affected protected species or their habitat.

10) *Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?*

Discussion: Applicable laws for the proposed action are summarized in Section 9. This action is consistent within the requirements of the M-SFCMA and will modify federal regulation. This action does not duplicate or threaten a violation of other federal, state or local laws. Several federal agencies have jurisdication to regulate activities associated with aquaculture, including the EPA, ACOE, MMS, and USCG. This amendment proposes no action that would supersede or duplicate the regulations of these agencies. Additionally, each Gulf state has authority to regulate aquaculture within territorial waters. State, local, and federal regulations may differ, but those differences and the requirements in this action would not threaten the protection of the environment

11) *Can the proposed action reasonably be expected to jeopardize the sustainability of any target species that may be affected by the action?*

Discussion: The proposed action is not expected to jeopardize the sustainability of any target species. Limited quantities of wild fish will be taken for use as broodstock. All species used for marine aquaculture will have to be native to the Gulf of Mexico and cannot be genetically

modified (Action 4). Non-indigenous species would be prohibited from being cultured. This will prevent competition for food and habitat between wild fish and non-indigenous fish. In the event that cultured fish escape from an aquaculture facility, competition for food and habitat is not likely to impact wild fish because the fish would be of similar genetic make-up.

12) Can the proposed action reasonably be expected to jeopardize the sustainability of non-target stocks?

Discussion: The proposed action is not expected to jeopardize the sustainability of non-target species. Limited quantities of wild fish will be caught as broodstock. While harvesting broodstock, small amounts of non-target species may be caught as bycatch, but the number of fish discarded would be small and comparable to a recreational or commercial fishing trip. The use of cages, net pens, or other grow-out systems may increase entanglement of fishes, marine mammals, protected species, and other non-target species. The NOAA Fisheries Service Protected Resources Division would be consulted during the review of proposed marine aquaculture systems and no systems would be improved if they are determined to jeopardize the sustainability of non-target species. Additionally, larvae, eggs, and small prey may be consumed by fish residing in net pens or cages. However, impacts are expected to be small given that natural mortality is high during the egg and larval stage for most marine species. Increased nutrient loading and water quality changes could impact habitat surrounding an aquaculture facility, but impacts are typically localized (see Section 6.1) and siting criteria would be used to avoid areas with essential fish habitat.

13) Can the proposed actions reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the M-SFCMA, and identified in FMPs.

Discussion: No, the proposed actions are not expected to significantly damage or impact habitat. The physical environment affected by actions in this amendment is described in Section 5 and impacts to the physical environment are discussed in Section 6 and Actions 5 and 6. The Council's preferred alternative in Action 6 would require NOAA Fisheries Service to review a proposed marine aquaculture facility site on a case-by-case basis. Criteria for reviewing the location of a site are provided in Table 6.7-1. Additional criteria may also be required by other federal agencies. These criteria are intended to prevent, or minimize to the extent practicable, impact to essential fish habitat and bottom habitat in general.

14) Are significant social and economic impacts interrelated with natural and environmental effects?

Discussion: Section 6.1 describes the potential biological impacts that may result from this action. These include, but are not limited to the spread of disease, habitat degradation, diminished water quality, escapement, etc. Measures proposed in this amendment are intended to prevent or mitigate such impacts (See Section 6.11), although some unavoidable adverse impacts may occur (Section 6.13). To the degree that the proposed measures prevent or mitigate environmental impacts, no significant social and economic impacts are expected to occur in relation to natural and environmental effects. Social and economic impacts are likely to be related to increased competition and public opposition to aquaculture by some stakeholders.

15) Is the proposed action reasonably expected to result in the introduction or spread of non-indigenous species?

Discussion: No, the Council's preferred alternative in Action 4 (Species Allowed for Aquaculture) would prohibit the use of non-native, genetically modified species for aquaculture. Only Council managed reef fishes, spiny lobster, stone crab, coastal migratory pelagics, and red drum would be allowed for aquaculture.

16) Will the proposed action result in cumulative adverse effects that could have a substantial affect on the target or non-target species.

Discussion: The cumulative effects of the proposed action are described in detail in Section 6.12. Significance factors #2 and #3 above describe expected impacts on target and non-target species. Cumulatively, allowing the development of an offshore aquaculture industry is expected to have a positive affect on target species by increasing MSY and OY above that which can be reduced by wild stocks. Additionally, offshore marine aquaculture may alleviate fishing pressure on some wild stocks. Currently, four stocks are undergoing overfishing in the Gulf of Mexico and two other stocks are overfished. Cumulative adverse effects on non-target species are not estimated to be substantial. For both target and non-target stocks, numerous actions throughout this amendment are intended to mitigate or prevent negative environmental consequences. These include: prohibiting non-indigenous species and genetically modified species from being used for aquaculture, requiring extensive permitting, recordkeeping, and reporting requirements, and evaluating marine aquaculture systems and sites on a case-by-case basis.

7.0 Regulatory Impact Review (RIR)

7.1 Introduction

NOAA Fisheries Service requires a RIR for all regulatory actions that are of public interest. The RIR does three things: 1) it provides a comprehensive review of the level and incidence of impacts associated with a proposed or final regulatory action; 2) it provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problem; and, 3) it ensures the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost-effective way. The RIR also serves as the basis for determining whether the proposed regulations are a "significant regulatory action" under the criteria provided in Executive Order (E.O.) 12866 and provides some information that may be used in conducting an analysis of impacts on small business entities pursuant to the Regulatory Flexibility Act (RFA). This RIR analyzes the probable impacts the alternatives in this plan amendment would have on potential Gulf of Mexico aquaculture businesses, the commercial fishing industry, processors and buyers of commercially harvested fish, recreational and for-hire fisheries, and various support industries.

This FMP amendment is different than most GMFMC amendments because it does not directly regulate (other than potentially creating some closed areas) commercial and recreational fisheries operating in the Gulf EEZ. Those amendments typically reallocate one or more species among

user groups using IFQs, permits, trip limits, time and area closures, or other traditional management measures. Instead, this proposed amendment would not directly alter the commercial and recreational fisheries in the GOM. Instead, it would provide the regulatory structure for persons to apply for aquaculture permits to operate in areas managed by the GMFMC. The offshore aquaculture industry, if it is developed, could have direct impacts on the environment and indirect impacts on the people, businesses, and communities that rely on the GOM fisheries. To the extent possible these impacts are discussed in this document. However, because of the uncertainty associated with the types of facilities that will be developed, the magnitude of individual operations and the industry in total, the species they will produce, and the changes that could occur in the technology, it is not possible to provide quantitative estimates of the impacts this amendment will have on the aquaculture industry and various sectors associated with the commercial and recreational fisheries.

7.2 Problems and Issues in the Fishery

The problems and objectives addressed by the amendment and the purpose and need for the amendment, are found in Section 3.0 of this document and are incorporated herein by reference. This amendment is intended to develop a permitting process that would allow aquaculture businesses to access approved areas in the Gulf of Mexico EEZ for their aquaculture systems, raise approved species, and harvest and sell their products.

A variety of Federal Agencies are currently tasked with overseeing various aspects of marine aquaculture. NOAA/NOAA Fisheries Service plays a role in the siting/permitting, operations, environmental impacts, user conflicts, species produced, food safety, monitoring and surveillance, industry assistance, research, and advising marine aquaculture development. Various other federal agencies also have roles in management and assisting the industry. Those federal departments include Agriculture, Commerce, Interior, Transportation, and Defense (Cicin-Sain et al. 2001).

7.3 Objectives

The objectives of this amendment are described in Section 3 and are incorporated here by reference. The major objectives identified for this plan amendment are to address the need for a regulatory structure that allows persons to obtain federal permits to operate aquaculture facilities in the Gulf of Mexico EEZ.

7.4 Description of the Fisheries

A detailed description of the fishing industry and aquaculture industry are contained in Section 5.3 of this document.

7.5 Impacts of the Management Alternatives

This section evaluates the economic impacts of management measures considered in this amendment. When possible, quantitative information is provided. If quantitative information is not available or cannot be derived using accepted economic techniques, a qualitative analysis is provided. Because the impacts of the proposed amendment will depend on future activity that

cannot be predicted with a reasonable level of confidence, much of the discussion will be qualitative.

Aquaculture Industry

Status quo management of offshore aquaculture in the Gulf EEZ would require persons to operate under a NOAA Fisheries Service EFP to be exempt from current Federal harvest regulations for species raised in an aquaculture facility. Additional permits and requirements implemented by other federal agencies[80] would also be required to operate the facility (Cicin-Sain et al. 2001). The activities covered by an EFP are described in 50 *CFR 600.745* (b).

> *"Exempted fishing—(1) General. A NMFS Regional Administrator or Director may authorize, for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited."*

The concept of offshore aquaculture is not explicitly included in that list of activities and the EFP structure is ill fitted for that purpose[81].

Development of offshore aquaculture facilities may require substantial investments of time and capital. Posadas (2003) estimated that a hypothetical six-cage production system would require an initial fixed investment of $2.89 million and annual operating capital of $1.28 million. Recouping investments of that magnitude would require a stable regulatory environment that provides adequate time for the firm to recoup both fixed and variable costs. The current EFP process does not provide the requisite stable regulatory environment needed to encourage the sizeable investment associated with any large-scale (i.e., viable) offshore aquaculture venture.

50 CFR 600.745 (c) (4) defines the duration of the EFP.

> *"Unless otherwise specified in the EFP or a superseding notice or regulation, an EFP is effective for no longer than 1 year, unless revoked, suspended, or modified. EFPs may be renewed following the application procedures in this section"*

Because EFPs are issued for a single year with the RA having the option of renewing the permit if the proper application is resubmitted, offshore aquaculture facilities would need to be able to cover all costs from the first year's revenue or be willing to accept loses that could result from

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80 Statutory Authorities for the regulation of offshore marine aquaculture are described in Table 4.6 of CSMP, 2001. That table indicates that up to 9 Federal Agencies (Animal and Plant Health Inspection Service, Army Corps of Engineers, U.S. Coast Guard, Environmental Protection Agency, Fish and Wildlife Service, Food and Drug Administration, Minerals Management Service, National Marine Fisheries Service, and the Office of Ocean and Coastal Resource Management) authorized under 15 separate Acts would need to be satisfied before a person could operate an aquaculture facility in the Gulf EEZ.

81 As stated in Section 3.0, "w]hile current regulations authorize NMFS to grant experimental fishing permits (EFPs) for aquaculture in federal waters, such permits are of limited duration and are not intended for the large-scale production of fish. AS a result, commercial aquaculture in federal wates is not viable under the current permitting process."

the permit not being renewed[82]. Financial institutions are less likely to provide capital if they are uncertain the permit would be renewed and the loan would be repaid. At a minimum, the financial institutions will charge higher interest rates to reflect the uncertainty of the repayment. The increased operating costs resulting from the higher interest rates will reduce the overall profitability of the firms.

The permitting process that must be followed for development of EEZ aquaculture businesses is often claimed to be one reason explaining why no offshore aquaculture has been sustained in the Gulf EEZ. Requiring aquaculture businesses to operate under an EFP introduces obstacles and risks for businesses, when coupled with other impediments, have not been overcome. Some of the other impediments to developing offshore aquaculture have been identified as (Cicin-Sain et al. 2001):

1. Potential Environmental Impacts Associated with Aquaculture
2. Public Opposition
3. User Conflicts
4. Economic Risks from Storm Damage
5. Availability of Investment Capital
6. Competition from Foreign Markets.

Interest in offshore aquaculture has been increasing, but the current regulatory structure has been one hindrance in the development of this industry. As stated in the EA, the NOAA Fisheries Service issued one EFP in 1997 for an offshore aquaculture operation off of Texas and since that time has received three additional requests for EFPs. In 2000, the Sea Grant Gulf of Mexico Offshore Aquaculture Consortium (GOAC) was formed to create a collaborative, Gulf-wide, university-based interdisciplinary research program to address social, environmental and technological issues associated with offshore aquaculture in the Gulf of Mexico. This program was later terminated because of a lack of federal funding. Most recently, the state of Louisiana created a Platform for Mariculture Task Force to assess the economic feasibility, environmental impact, and legal/regulatory considerations of utilizing offshore oil and gas platforms for culturing marine organisms in the Gulf. Given the history of offshore aquaculture under the current regulatory environment[83], it is unlikely that firms would be able to start, let alone sustain, an economically viable commercial offshore aquaculture operation under the current regulatory environment.

Commercial Fisheries

Commercial fisheries regulations in the Gulf of Mexico will not be altered as a result of maintaining the status quo. Harvests among participants in those fisheries will continue to be restricted by traditional management measures[84] and the commercial quota set under TAC.

82 Furthermore, failure of a permittee to comply with the terms and conditions of an EFP may be grounds for revocation, suspension, or modification of the EFP. Any action taken to revoke, suspend, or modify an EFP for enforcement purposes is governed by 15 CFR part 904, Subpart D.
83 This assumption does not take into account congressional actions that are currently being considered to address offshore aquaculture. Implementing the proposed bills could modify the regulatory structure to allow offshore aquaculture to develop, regardless of the actions taken in this amendment.
84 These include fishing permit requirements, trip limits, time and area closures, gear restriction, etc.

Because the harvesters operate in a competitive market where the barriers to entry are low (a permit in most cases) they are expected to earn only normal returns on investment. Rents are dissipated when persons holding the permits[85] increase fishing costs by buying equipment that allows them to harvest fish faster at times of the year when the fishing season is open. Flooding the market with product when the fishery is open may also lead to reduced ex-vessel prices (NRC 1999). Costs above those needed to harvest the fish and concentrated periods of landings that reduce ex-vessel prices tend to dissipate economic rents. Because rents are dissipated, the producer surplus, with the exception of some infra-marginal rent, is also likely to be largely dissipated.

The one Gulf of Mexico fishery where rents could be earned by persons receiving an initial allocation of quota is the red snapper IFQ fishery. Those rents are captured in the sales price of the quota, so persons buying into the fishery would be expected to pay a higher price for the quota to reflect the rents generated in the fishery. The final rule[86] implementing the IFQ program indicated that 95 IFQ holders would be issued quota shares based on activity as a Class 1 permit holder; an additional 482 Class 2 permit holders would be issued quota shares for the red snapper fishery. Over time the number of quota share holders is expected to decline as the participants attempt to match their harvesting capacity with the amount of quota they hold. Persons leaving the fishery will be compensated for exiting the fishery at the market value of the quota shares. Any rents earned in the fishery would be the amount of producer surplus generated.

Revenues and Ex-vessel Prices

The revenues generated from the commercial fisheries (i.e., king and Spanish mackerel, reef fish and red snapper, spiny lobster, etc) will be determined by how much the harvester is able to catch and the price they receive for their catch. Persons holding the permits will be allowed fish based upon restrictions imposed on the permit and other fishery regulations.

The ex-vessel prices received by the commercial fishing sector are in part determined by the consumer demand for those species, substitute products, and the available supplies. It is assumed that demand for species commercially harvested from the Gulf of Mexico is unaffected by maintaining the status quo. Increases in the U.S. population and per capita income over time, however, is expected to increase demand for a variety of seafood products; including species harvested from the Gulf of Mexico. This trend is reflected in U.S. edible seafood imports which have increased from 5.6 billion pounds (round weight) in 1990 to 10.2 billion pounds (round weight) in 2005.87. .

Assuming the U.S. supply of wild caught species harvested from the Gulf of Mexico do not increase significantly,, the most likely source of increased supply of Gulf of Mexico species would come from imports of wild or farm raised fish. Since wild stocks are fully exploited in most parts of the world, the increased supply is more likely to come from aquaculture production. Currently, research is being conducted in the Caribbean, Asia, and other areas of the

85 Usually more permits are issued than are needed to harvest the total allowable catch.
86 Federal Register Volume 71, No. 225, Wednesday, November 22, 2006, p. 67447-67462
87 By comparison, domestic commercial landings of edible products equaled 7.0 billion pounds (round weight) in 1990 and 8.0 billion pounds in 2005.

world to produce species harvested commercially from the Gulf of Mexico. The offshore areas of the Southern United States and the Caribbean Countries have extraordinary potential for the development of an environmentally sustainable marine aquaculture industry (Benetti et al. 2003). A demonstration project to assess the technological feasibility and possible environmental effects involved in adapting cutting-edge technology to culture *Lutjanus analis* (mutton snapper) and *Rachycentron canadum* (cobia) in submerged open-ocean cages in Puerto Rico was conducted in 2004 (Alston et al. 2005). This project has now become a full time operational facility, Snapperfarm.

Areas of the ocean outside of the Gulf of Mexico are suitable to raise species commercially harvested from the Gulf and the production technology being developed to grow species from the Gulf can be deployed in those locations. Therefore, it is anticipated that commercial Gulf of Mexico fishermen (and fishermen from other areas that harvest those species, e.g. South Atlantic) will compete with a growing amount of imports; whether an offshore aquaculture industry develops in the Gulf of Mexico or not. If those imports are viewed as close substitutes for Gulf species and if markets for these species do not grow, they could reduce the ex-vessel prices received by commercial harvesters. The actual decrease in ex-vessel price will depend on how well commercial fishermen can differentiate their products from the imports and the price flexibility[88] of the species harvested. If domestic production also increases, it could also add to the increased supply of fish on the market and compete with wild harvests. The increased supply of fish on the market could put downward pressure on ex-vessel prices received by harvesters of wild stocks in the Gulf and other regions of the U.S.

Economic theory can help provide some basis for considering the impact of offshore aquaculture on domestic welfare in instances where imports, in the absence of increases in domestic production, are anticipated to increase. The outcome is somewhat different depending upon whether one assumes that imports are a perfect substitute for domestic product (either wild catch or aquaculture) or an imperfect substitute. Under the first scenario, demand for imports can be specified as follows (see Goldstein and Kahn 1985):

$$D = f(P,Y) \qquad f_1 < 0,\ f_2 > 0$$
$$S = g(P,F) \qquad g_1 > 0,\ g_2 < 0$$
$$I = D - S$$

Where D is the total quantity of some species, say red snapper, demanded in the United States, S is the supply of the product (red snapper) produced in the United States, P is the domestic price of red snapper, Y and F and money income and factor costs, and I is imports.

Two salient features of this model are apparent. First, the demand for imported red snapper represents an "excess" demand for the domestically produced product. Second, assuming demand and supply conditions in the United States are too small to affect world price of the product, an increase (decrease) in the domestic supply of red snapper will reduce (increase) import demand with no corresponding change in price.

88 Usually stated as the percentage change in price that would be caused by a one-percent increase in the quantity produced.

Assuming the imported product (say, red snapper) to be an imperfect substitute for the domestic product, import demand can be derived as follows (see Goldstein and Kahn, 1985, for more detail on the model):

$$I^d = f(Y, PI, P) \qquad f_1, f_3 > 0,\ f_2 < 0$$
$$I^s = g(PI, P^*) \qquad g_1 > 0,\ g_2 < 0$$

where I^d is the quantity of imported product (red snapper) demanded in the United States, I^s is the quantity of imports supplied to the United States from the rest of the world, I is the equilibrium level of imports, PI is the price paid by the United States for imported product (abstracting from exchange rate differentials), P is the domestic price for red snapper, P^* is the price of red snapper in the rest of the world, and Y is money income in the United States. A fourth equation, depicting the establishment of the red snapper domestic price in the United States (from wild harvest or aquaculture) can be given as follows:

$$P = h(L, I, Y) \qquad h_1, h_2 < 0 \qquad h_3 > 0$$

where L is the domestic production (i.e., wild harvest or domestic aquaculture) of red snapper.

The demand for imported product (red snapper), as identified in the first equation, responds positively to increases in money income and the domestic price and negatively to increases in the imported price, *ceteris paribus*. The supply of imports is positively related to the import price and negatively related to the "rest of the world" price. Finally, the domestic price, as specified, is negatively related to domestic production (wild harvest and aquaculture production) and imports and positively related to income.

As specified, the red snapper domestic price equation can be substituted into the import demand equation yielding:

$$I^d = f(Y, PI, h(L, I, Y))$$

or, after respecifying:

$$I^d = i(Y, PI, L)$$

Demand for the imported product (red snapper), as now specified, is related directly to domestic production. As domestic production increases (from wild harvest or aquaculture), import demand decreases and vice versa.

These alternative import demand scenarios, while theoretical in nature, can be used to help qualitatively assess changes in producer and consumer surplus associated with increasing domestic aquaculture production. Under the perfect substitute scenario, imported product will simply be displaced by any increases in domestic production forthcoming from offshore aquaculture production. As such, there will be no change in consumer surplus and no change in producer surplus associated with the domestic harvest of the wild product. Additionally,

assuming offshore aquaculture operations are successful, there will be producer surplus in that sector. Hence, total market-based surplus in the United States will be enhanced.[89] The gain in surplus in the United States will come at the expense of a reduction in producer surplus among exporting countries.[90]

Import demand, in response to offshore aquaculture, will also decline under the context of this model, but there need not be total displacement of the imported product in association with increases in the domestic product. Hence, there is some potential of a reduction in producer surplus among producers of the wild product. As noted, however, with the exception of red snapper, where an IFQ program has recently been established, producer surplus is thought to be relatively limited in most of the Gulf-managed fisheries. If successful, producer surplus in the offshore aquaculture sector will be positive and almost certainly larger than losses in producer surplus in the wild harvest sector. Finally, one can conclude with certainty that consumer surplus will either remain constant or, more likely, increase. Hence, one is able to state with a relative degree of certainty that total domestic surplus captured in the market will be enhanced with the establishment of a successful offshore aquaculture program.

As discussed in Section 5.3, there are several primary candidate species for offshore aquaculture in the Gulf; red snapper, redfish, pompano, and cobia. While there is no information on the imports of red snapper, total fresh snapper imports increased from less than 11 million pounds in 1991 to more than 27 million pounds by 2005. Gulf harvest of snapper has consistently fallen in the relatively narrow range from about seven million to 10 million pounds annually during this period. The price of the harvested product in 1991 equaled $1.99 per pound compared to $2.42 per pound in 2005. Expressed on a deflated basis, the dockside price of the Gulf snapper product fell by 15 percent, from $1.46 to $1.24. The decline in the deflated price is, most likely, the result of an increasing import base of red snapper or a close substitute. Without the large increase in disposable income during the period, furthermore, one would have expected the deflated price to fall by a significantly larger percentage.

The price of the fresh imported product averaged $1.89 in 2005 compared to $1.49 in 1991. With few exceptions, the price differential between the domestic product and imported product has been about $0.25 to $0.50 per pound with the domestic product consistently receiving a higher price (see Section 5.3). On a deflated basis, the price differential rarely exceeded $0.30 per pound and there was no evident trend toward either an increasing or decreasing differential during the 1991-2005 period. The historical price differential can reflect any number of factors including, but not limited to, different compositions of snapper products (e.g., the domestic fishery may have a higher share of red snapper in the mix), seasonality, size of the product, or freshness.

While providing a precise estimate of substitutability between domestic Gulf snapper product and imported product is not possible in the absence of a more formal analysis (e.g. cointegration analysis), the available data would suggest that they are relatively close (if not perfect)

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89 As discussed later, surplus not captured in the market (third-party surplus emanating from positive and negative externalities associated with offshore aquaculture operations is also relevant to the analysis).
90 The issue of surplus to parties outside the market is addressed in some detail in subsequent sections of this analysis.

substitutes for one another. If this conclusion is correct, successful offshore aquaculture production of species in the snapper family may result in a decline in imported snapper product and, hence, little change in producer surplus associated with the domestic harvesting sector. If the market for snapper grows or if new markets for snapper are created, then the increased production from domestic offshore aquaculture may substitute for future increases in imports. While the import data is not at a level of detail required to examine the price differential between imported and domestic product associated with many of the other Gulf finfish species (there is also little domestic ex-vessel price information on redfish), it is likely that results similar to that observed for snapper would be found if the data were available.[91] While some species, such as cobia, are not likely to be imported in significant quantities under prevailing conditions, as offshore aquaculture advances in other countries, increased exports of these products to the U.S. are expected. Successful offshore aquaculture in the Gulf may result in a lower import demand for these species.

Community Impacts

Community impacts are generally discussed in terms of increases or decreases in local expenditures and employment. As discussed earlier, an offshore aquaculture industry is not expected to develop under the status quo. Therefore, communities are not expected benefit from increased expenditures by aquaculture businesses or the creation of new jobs.

The commercial fishing industry supports jobs and makes purchases in fishing communities. These expenditures have traditionally occurred in the communities discussed in Section 5.3. The magnitude of these expenditures would not be expected to change as a direct result of this action. However, indirect impacts could result from changes in imports (wild or aquaculture) that may occur under any alternative.

The price flexibility of Gulf of Mexico species[92] provides an indication of the expected change in ex-vessel price associated with a change of available quantity. Increases in the supply of a species are expected to reduce prices if there is no shift in demand or the demand shift does not offset the increased supply. Reductions in ex-vessel prices could reduce the expenditures by commercial harvesters, because they have less revenue to spend at a given level of production.

Processing activity in communities that historically process finfish imports would benefit from increased imports. As noted in Section 5.3, however, processing of imported finfish in the Gulf appears to be relatively limited (at least for reef fish and coastal pelagic species). However, most fishing communities are not expected to share in the increased economic activity those results from imports.

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91 For grouper, the domestic dockside price exceeded the imported price of fresh product by a considerable margin during the 1990's. The price differential has gradually been declining, however, and since 2004 there has been little or no price differential.

92 Price flexibility estimates are not available for Gulf of Mexico species. Future research in this area would be beneficial as would research on whether imports or aquaculture products are considered close substitutes for wild caught species from the Gulf of Mexico.

In summary, continued increases in the quantity of imports from wild stocks or aquaculture outside the Gulf of Mexico will decrease commercial ex-vessel prices for Gulf species, if the own-price and cross-price flexibility of those species are negative and if market demand does not rise to absorb additional (imported) supply. Assuming the Gulf commercial TAC of those species remains constant over time, the revenues and profits for commercial harvesters would decline. The communities where those harvesters reside or make purchases will also be negatively impacted, unless the community is home to reprocessing or distribution centers for the imported fish. Additional research would be needed to estimate the magnitude of the decreased economic activity in the various communities where is activity would occur.

7.5.1 Types of Aquaculture Permits Required

In addition to the status quo, the Council is considering two alternatives for issuing offshore aquaculture permits. Alternatives under consideration are presented in this section, and to the extent possible, a qualitative discussion of the economic impacts associated with selecting each alternative is provided

Alternative 1: No action (status quo). An Exempted Fishing Permit (EFP) for conducting aquaculture scientific research activities in the Gulf EEZ would be required.

Continuation of the status quo would not result in any new permits designed to supersede the commercial fishing regulations aquaculture firms must currently operate under. The current permitting process has been described by Goldburg et al. (1996), Bunsick (2003), and in the EIS of this amendment. The MSFMCA provides guidance regarding how NOAA Fisheries Service and the Regional Fishery Management Councils manage fisheries in the EEZ waters.

The current regulatory structure allows the NOAA Fisheries Service Regional Administrator (RA) to issue an EFP that is in effect for up to one year. That permit may be renewed at the judgment of the RA. Persons wishing to develop an offshore aquaculture business in the Gulf EEZ would need to structure a business plan based on operating within the EFP permit process.

It is assumed that the time to provide the information required is 1 hour for the initial issuance of the EFP, and 1 hour for any subsequent requests (OMB 0648-0309). These estimated response times include the time needed for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Other permits would also be required that are not directly addressed or modified in this amendment. The Rivers and Harbors Act of 1899 (33 U.S.C. 403) and the Outer Continental Shelf Lands Act of the Army Corps of Engineers (43 U.S.C. 1331-1356) provide the ACOE the authority to require permits for any structure that may obstruct navigation in U.S. waters. Open-ocean aquaculture facilities would fall under those criteria.93

93 As noted by in the Marine Aquaculture Task Force report (2007), "[n]et pens or sea cages are potential hazards to navigation and hence fall under the purview of the U.S. Army Corps of Engineers (COE) in its responsibility to

The Clean Water Act (33 U.S.C. 1251 *et seq.*) and Marine Protection, Research, and Sanctuaries Act (16 U.S.C. 1431 *et seq.*) provide the EPA the authority to require point source pollution discharge permits. However, the application to offshore aquaculture is somewhat ambiguous.94

Development of offshore aquaculture businesses would continue to be hampered by the current permitting process. Given that no offshore aquaculture businesses currently operate in the Gulf EEZ, the economic impact of the status quo would be to continue to constrain development and economic benefits that could be derived under an alternative regulatory framework that that is more conducive to investment. Net National Benefits, in terms of producer and consumer surplus, would be expected to be stable in the near term. In the longer-term, advances in aquaculture production techniques in other countries would likely increase imports of seafood (the same species or close substitutes to those harvested in the Gulf) into the U.S. The increased supply would reduce commercial ex-vessel prices and revenue, but would likely increase consumer surplus.

Preferred Alternative 2: Require a NOAA Fisheries Service permit to operate a marine aquaculture facility in the Gulf EEZ.

Alternative 2 would create a new permit and **Alternative 3** would create two permits that would be issued by the Secretary of Commerce. The permit(s) would be required before a person could develop and/or operate an offshore aquaculture facility in the Gulf EEZ. The permit requirements, application process, and recordkeeping and reporting requirement decisions are defined under Actions 2 through 8.

Under **Alternative 2**, a single permit issued by NOAA Fisheries Service would be required to operate a marine aquaculture facility in the Gulf EEZ[95]. The Regional Administrator on behalf of the Secretary of Commerce would issue the permit. Without the permit, the owner would be required to either (a) obtain an EFP and abide by the regulations associated with that permit or (b) abide by the TAC, trip limit, and gear regulations in place for each federally managed species.

The cost of obtaining a permit under **Alternative 2** is expected to be exceedingly minor relative to other start-up costs[96]. Without additional information, it is assumed that the time requirements for this permit would be similar to those described for an EFP (1 hour per application). . The actual cost of the permit would be determined by the application process, permit requirements, and any additional fees associated with issuance of the permit. Those decision points are discussed in the other actions of this amendment.

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administer the Rivers and Harbors Act of 1899. Under this act, the COE must conduct a public interest review and provide a permit under section 10 of the Act for hazards to navigation in U.S. waters."

94 As noted in the Marine Aquaculture Task Force report (2007). "[u]nder the Clean Water Act, most net pen or sea cage aquaculture facilities require a permit to discharge pollutants into U.S. waters (p. 24)."

95 This single permit would merely replace the EFP. Other relevant permits, as specified by law, would still be required.

96 As noted, Posadas (2003) estimated that a hypothetical six-cage production system would require an initial fixed investment of $2.89 million.

The overall economic impact of issuing this permit in lieu of the EFP could be substantial. The current regulatory process (i.e., the EFP), as noted, is thought to suppress offshore aquaculture investment due to uncertainty as to whether the EFP will be renewed on a continuing basis. If the permit to be issued under **Alternative 2** provides for a greater degree of long-term certainty, investment in offshore aquaculture is likely to be enhanced. , This increased investment has the potential to create a new industry capable of increasing the total yield of commercially targeted Gulf species.97 . However, predicting the magnitude of the economic impact is problematic given the uncertainties associated with obtaining the permits, the cost structures of operations in the Gulf EEZ, markets for aquaculture products, and impacts of natural forces (e.g., hurricanes) on the operations.

Development of the industry may help offset anticipated future increases in imports in total and, as discussed in Section 5.3, imports of many of the more important products harvested in the Gulf (e.g., snappers, groupers, and shrimp). As the technology to raise species that directly compete with wild Gulf of Mexico products (e.g., reef fish species) is fine-tuned, imports of those products, in the absence of an increase in domestic production (either wild harvest or offshore aquaculture) will increase. If the production of those species takes place outside the U.S., the economic activity associated with that production would not benefit communities close to the Gulf.

As with the status quo, harvesters of competing wild product could realize reductions in ex-vessel prices and revenue under **Alternative 2**. The difference in commercial ex-vessel price changes under the status quo and **under Alternative 2** cannot be predicted and would, to a large degree, depend upon the substitutability of the offshore aquacultured product and the imported product. If U.S. production of offshore aquaculture product displaces an equal amount of otherwise imported product (i.e., the offshore aquaculture product is a perfect substitute for the imported product), the overall increase in net benefits to the U.S. would be positive. Changes in consumer surplus would likely be the same, assuming product quality is similar in U.S. production and imported products. Producer surplus could increase if the aquaculture industry or industries that support aquaculture production generate economic rents.

Limited economic literature exists for U.S. offshore aquaculture (Kolian and Sammarco 2005). An economic analysis of the feasibility of offshore aquaculture in the Gulf of Mexico provided general guidance on costs and production levels (Louisiana Sea Grant, 2001). Sea Grant determined that offshore production, using net-pens, is technically feasible, but would require the development of hatcheries to provide fingerlings. Other studies have reached less favorable conclusions. Posadas and Bridger (2004) found that:

> *"The culture of cobia, red snapper and red drum using commercial offshore cages and the proposed aquaculture support vessel in the Gulf of Mexico has limited economic potential given the present biological information, cost structure of the offshore production technology, and established ex-vessel market prices".*

97 In essence, the Maximum Sustainable Yield (MSY) from wild harvest is constrained by the carrying capacity. One can view offshore aquaculture as a means of artificially increasing MSY (see Section 3.0).

Until more information is available on who will apply for permits and the types of businesses they intend to develop, it is not possible to project with any certainty the magnitude of the economic impacts that will result from issuing permits. However, if the status quo is maintained, it will continue to suppress offshore aquaculture businesses opportunities. Limiting that opportunity could constrain net national benefits that could be derived from offshore aquaculture in the Gulf.

Alternative 3: Require separate siting and operating permits for an aquaculture facility in the Gulf of Mexico EEZ. A Siting permit would specify the duration, size, and location of a marine aquaculture facility and an Operating permit would specify the marine species to be propagated, reared, or both, and design, construction, and operational details.

Alternative 3 requires a person to obtain two NOAA Fisheries Service permits prior to installing and operating an aquaculture facility in the Gulf EEZ.98 The two-permit structure reflects language from The National Offshore Aquaculture Act of 2005 bill that was not enacted. Under that legislation the Secretary of Commerce would have been authorized to issue an offshore aquaculture site permit. The permit would be site specific, and if the permit holder wants to move the operation to a new location he/she would need to obtain a new permit. It is also assumed that offshore aquaculture operations located on facilities regulated under the Outer Continental Shelf Lands Act would be jointly and severally liable for the removal of any construction or modifications related to aquaculture operations. The Secretary would also be authorized to issue operating permits that regulate marine species to be propagated and/or reared and the design, construction, and operational details of the business. Operational permits could be linked to a specific site permit. The Secretary may require that an operational permit is issued for use at a specific site within a specified amount of time or the site permit could be revoked. The revised National Offshore Aquaculture Act of 2007 (Appendix B) simplifies the permitting structure into a one permit system.

Whether a person is required to hold a single permit (**Alternative 2**) or separate siting and operating permits (**Alternative 3**) is not expected to significantly influence permitting costs. This reflects, in part, the fact that much of the information that would be required in **Alternative 3** are also required elsewhere in this Amendment (see Actions 3, 4, and 6) and/or are required by other agencies. For example, information related to the proposed NOAA Fisheries Service siting permit would also be required by the ACOE for the requiste Section 10 permit if the structure is likely to obstruct navigation in U.S. waters.

The economic impacts of selecting **Alternative 3** are similar to those that would be realized if **Alternative 2** was selected. Both have the potential to provide a structure that could create a new aquaculture industry in the Gulf. The feasibility of creating those businesses is still uncertain, based on the literature which is currently available.

98 In addition to these two permits, other permits, as mandated by statute, would also be required. Possible requisite permits are discussed in Section 5.4.1.

7.5.2 Duration of the Permit[99]

Offshore aquaculture, by its very nature, will be capital intensive with significant costs likely occurring years prior to the generation of any stream of revenues. Investment, therefore, will only occur if the lessee has some certainty that he will be able to recoup all upfront costs (i.e., sunk costs) and, over time, realize a positive return on his investment (i.e., a stream of revenues that allows the investors to recoup the sunk costs and all variable costs) [100]. In addition, investment will be forthcoming only if the expected return from the aquaculture venture is equal to or exceeds the expected return from alternative investment opportunities.

The duration of permits from other agencies will also impact aquaculture firms. For example, the Army Crop of Engineers Standard Operating Procedures for the Regulatory Program state that the duration of permits issued for structures (e.g. net pens) are determined by the district engineer. If required permits issued by the EPA and ACOE are of shorter duration than the aquaculture permit, it may have negative impacts on the development of offshore aquaculture.

The timeframe needed to generate a revenue stream and, ultimately, realize a positive return on investment is likely to vary from one species to another. For faster growing species, a stream of revenues may be forthcoming within a matter of a couple of years. For slower growing species, revenues may not be realized for several additional years. Though revenues may be generated more rapidly with the faster growing species, this does not necessarily translate into the realization of a more rapid positive return on investment. Furthermore, even if the faster growing species do realize a more rapid positive return on investment, long-term profits (i.e., stream of revenues above all sunk and variable costs) associated with some of the slower growing species may be higher than that which could be realized for the quicker growing species[101]. Hence, any system that limits the duration of a permit to less than that needed to realize a profit associated with the growing of some species (and a profit equal to or exceeding other investment opportunities) may, potentially, limit the species that would otherwise be grown. Furthermore, any permit of a limited length will inhibit investment in new technology, with investment decreasing in relation to the amount of time remaining before the permit expires. Hence, permits of a limited duration are likely to have the perverse effect of discouraging entrepreneurs from investing in new technologies that would reduce the cost of production. This consideration is particularly relevant in a new industry, such as offshore aquaculture, where technology is rapidly evolving.

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99 As noted, failure of a permittee to comply with the terms and conditions of an EFP may be grounds for revocation, suspension, or modification of the EFP. Any action taken to revoke, suspend, or modify an EFP for enforcement purposes is governed by 15 CFR part 904, Subpart D. At this time, it is not known what actions by the permittee may result in suspension or revocation of the proposed alternative permit(s) specified under Action 1 (Alternative 2 and Alternative 3). For purposes of analysis, it is assumed that terms and conditions are similar to those pertaining to the EFP .

100 While there is considerable uncertainty regarding "upfront" costs for a "standard" offshore aquaculture facility, all available studies indicate significant costs. For example, estimated total start-up and capital costs for using a converted offshore oil-and-gas platform, calculated by Waldemar Nelson International Inc. (1996) equaled $6.8-$7.5 million. Posadas and Bridger (2003) provide an estimate of total fixed costs equal to $2.9 million based on an operation consisting of six 3,000 m^3 cages. Section 2.2 of this Amendment suggests start-up costs of $5 million.

101 In particular, the output price associated with some of the slower growing species may be considerably higher than that which one would receive for the faster growing species.

The potential for discouragement from investing in new technologies is, of course, the result of incomplete property rights if the duration is limited. Absence of secure property rights tend to decrease long-run efficiency and, hence, net benefits to society.

Given the high upfront costs, offshore aquaculture entrepreneurs will, in many instances, need to finance their operations. Banks and lending institutions will finance offshore aquaculture operations only if there is some certainty that the aquaculture operation is financially sound with derived income sufficient to pay principal and interest on any loans. As noted by Cincin-Sain et al. (2005); "[a]vailability of capital has been a problem for the aquaculture industry for years and will continue to be a problem for firms planning to work offshore (p. 20)." The authors go on to state that banks and lending institutions will "…require security of tenure in the form of long-term, renewable leases[102]." In addition to these issues, profitability in any aquaculture venture can fluctuate widely in the short run. This fluctuation is the result of variability in both output (due to, say, loss from hurricanes) and in output price. More secure tenure, tied directly to the permit duration, gives the investor the ability to reduce risk costs by riding out short-term output fluctuations and/or market fluctuations[103].

If offshore aquaculture activities are expected to be profitable in the long run, there will be a derived demand for open ocean space.[104] This derived demand, if met, may potentially translate into enhanced benefits to society. These benefits reflect increases in consumer, producer, and third party surplus.

As noted, if the imported product is a perfect substitute for the domestically produced product (i.e., wild harvest and offshore aquaculture product), offshore aquaculture production will merely displace imported product and consumer surplus will remain unchanged. If the imported product is an imperfect substitute for domestic product, consumer surplus is likely to be enhanced.

Producer surplus is roughly equivalent to profits[105]. As noted, if the imported product is a perfect substitute for the domestically produced product, producer surplus from the domestic captured fishery will, in theory, remain unchanged but total domestic producer surplus will be enhanced as a result of rent generation in the offshore aquaculture sector.[106] If the imported product is less than a perfect substitute for the domestic product (captured and offshore

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102 The authors also state that for the lease to have any value as collateral, provisions must be made for transferability of that lease to other operators employing similar techniques and/or technology.
103 As stated by the Marine Policy Center, Woods Hole Oceanographic Institute (2001), "tenure [in an aquaculture facility] is analogous to the investment horizon for holding securities (p. 69)."
104 The term "ocean space," as used by the Marine Policy Center merely refers to the area encompassed by an ocean. As such, the terminology is not meant to imply whether there is prior existing or other potential uses of the space. A similar meaning of the term is implied when it is used in this section of the document.

105 See Just et al. (2004) for a more detailed discussion of producer surplus, including alternative definitions.
106 Producer surplus can be enhanced in the aquaculture industry and also in related markets. For example, successful aquaculture may provide additional raw material for processing activities to established dealers (assuming processing is not undertaken directly by the aquaculture facility). This, in theory, could enhance profitability in the existing processing sector, assuming raw material is a current binding constraint. Keithly and Martin (1997) indicate that excess capacity in the reef fish processing industry is large. Under this scenario, producer surplus in the processing sector is likely to increase if there is a constant markup which covers all expenses (including normal returns on investment).

aquaculture produced), there is some potential for reduced producer surplus in the captured fishery sector. As previously discussed, however,, a lack of even weak property rights in most of the Gulf managed fisheries would suggest that producer surplus is somewhat limited (comprised, primarily, of inframarginal rents). The combination of the limited property rights and the reduction in imports emanating from offshore aquaculture provides justification for a conclusion that gains in producer surplus in the offshore aquaculture sector will exceed any losses in producer surplus from the domestic capture sector.

Consumers and producers make decisions based upon changes in the marketplace (e.g., output price) and changes in producer and/or consumer surplus are tied directly to these changes. Parties outside the market may also benefit from open ocean aquaculture.[107] For example, recreational fishing (e.g., average catch per trip) may be enhanced due to changes in the complex ecosystem web from offshore aquaculture activities that, say, increase the available fish feed and, hence, survival and growth of the wild stocks[108]. From an economic perspective, the value of this is equal to willingness to pay for this change by the recreational fishing sector. Given that this change in welfare occurs outside the market, it is considered an external benefit.

A second example of an external benefit relates to the change in wild stock sizes that could occur as a result of successful offshore aquaculture. Specifically, some members of society derive benefits from the knowledge that wild stocks are in a "healthy" status and would be willing to pay accordingly. Assuming imports to be an imperfect substitute for the domestic product, there may be less than perfect displacement of imports associated with increased offshore aquaculture (for example, a ten-million pound offshore aquaculture production may result in only an eight million pound reduction in imports of same/related products). In such a situation, competition of the offshore aquaculture species with wild-caught species in the marketplace may result in a reduction in the dockside price of the captured species (the extent of the reduction depending upon the cross-price flexibility, assuming imperfect substitutes). To the extent that this reduction in output price maps into a reduction in effort, wild catch may, in theory, decline; leading to

107 There may also be costs to parties outside the market. These costs are considered momentarily.
108 One should realize that this is merely a hypothetical example. It is also conceivable that antibiotics or components of fish feed could negatively impact recreational (or commercial) fishing activities. As discussed in the environmental impact assessment of this document (Section 6.1), however, the probability of such an impact is believed to be remote.

"healthier" stock status for some species.[109] Again, since this change in welfare occurs outside the market, the change in benefits is considered external[110].

Considering benefits in this manner, it becomes clear that tenure duration of insufficient length will reduce societal benefits. In the extreme (i.e., where the duration period is so short or there is so much uncertainty about its duration that no investment is forthcoming), benefits will be zero[111].

The benefits of longer tenure (i.e., effective duration of the permit) must, however, be weighed against the costs. There are three (potential) primary costs associated with offshore aquaculture: private costs, external costs, and administrative costs. Private costs are represented by those internal to the offshore business venture (capital, labor, etc.) Reductions in producer surplus in other markets, such as to harvesters of the wild product, via a reduction in output price also represent a private cost[112]. External costs reflect activities conducted by the business venture which detract from the welfare of society and for which society is not compensated[113]. These

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109 Assuming profit maximization, economic theory can be used to show that a reduction in output price results in a reduction in industry output, *ceteris paribus*. While remaining firms in the industry may increase their respective level of effort, total industry effort will decline. While one might argue that the reduction in effort will imply losses to Gulf communities, this need not be the case. Specifically, offshore aquaculture is likely to provide jobs to these communities. If the imported product is a perfect substitute for the domestic product (either wild or offshore aquaculture produced), one can state with some certainty that community jobs will be enhanced (the possible exception being that, unlikely, situation where employment associated with offshore aquaculture is outside the coastal communities). If the imported product is not a perfect substitute for the domestic product, one may experience some job loss in coastal communities associated with a reduction in wild harvesting activities. These losses, however, need to be weighed against the gains from employment associated with offshore aquaculture activities. These gains will, at least to some extent, mitigate losses in the commercial fishing sector and could conceivably outweigh any losses by a significant factor (e.g., if offshore aquaculture output is processed onshore). Without additional information, however, it is impossible to determine whether employment gains from offshore aquaculture will exceed employment losses

110 Anderson (1985) presents a formal model of the market interaction between aquaculture and capture fisheries whereby increased aquaculture supply results in increases in the natural fish stock. It is assumed that there are no production interactions. There is ample evidence that large increases in aquacultured products negatively impact the ex-vessel prices of related captured species (see Keithly and Roberts, 2000). While not empirically verified, there is little doubt that the reduction in ex-vessel shrimp price as a result of an increasing base has resulted in a reduction in effort.

111 As noted under Action 1, the issue of whether offshore aquaculture will be profitable in the long run, given the current technology, is highly uncertain under even the most favorable institutional and regulatory conditions. If expected long-run profitability is below that of other investment ventures, investment in offshore aquaculture will be zero. In this case, benefits (and costs) associated with aquaculture will be zero; regardless of tenure length.

112 Note that while offshore aquaculture may result in a loss to producers in related markets (i.e., a reduction in producer surplus), it may also provide benefits to consumers (i.e., an increase in consumer surplus). Whether net benefits in the related markets increase or decrease depends on the elasticity of demand. Furthermore, and perhaps more relevant, producer surplus in most Gulf fisheries is expected to be relatively low since management regimes, in general, have not attempted to maximize producer surplus. Specifically, while most (if not all) of the Gulf of Mexico Fishery Management Council's managed fisheries are under some form of limited entry, only the red snapper fishery is managed under an IFQ program. There exists a large body of literature suggesting that producer surplus is likely to be limited in the absence of an IFQ program. Hence, one can conclude that reduction in producer surplus in the related capture fisheries may be relatively limited.

113 One can view these external costs as the amount of income that society would be willing to pay to avoid adverse impacts (i.e. impacts that reduce the welfare of society) associated with offshore aquaculture.

costs, by definition, occur outside the market[114]. In addition to these two cost components, one must also consider government expenditures in support of public interest (e.g., enforcement)[115]. Combined, these costs represent the total costs to society from offshore aquaculture. Benefits less costs (i.e., Net National Benefits) provide a metric for measuring the change in societal welfare associated with each of the alternative leasing durations.

As noted by the Marine Policy Center, "…the public is the "owner" of ocean space (p. 56)" and to the extent that an offshore aquaculture facility displaces other beneficial uses of the resource (including other aquaculture facilities) without adequate compensation, an external cost is imposed on society.116 If, for example, there were no other beneficial uses of the resource (i.e., ocean space), the external cost to society from the aquaculture facility using that space (i.e., the opportunity costs associated with that space) would be zero. External costs, however, increase commensurately with increasing beneficial uses of the ocean space.

For example, displacement of commercial and/or recreational fishermen from preferred fishing locations due to the siting of aquaculture facilities would be considered an external cost and this cost would increase commensurate with the number displaced. The siting of aquaculture facilities may also result in some external costs associated with shipping and mineral extraction. Similarly, placement of an aquaculture structure on an area designated as essential fish habitat would represent external costs to society if such placement results in lower wild fish stocks. However, current regulations and or regulations that may be enacted in association with this amendment may marginalize many of these, otherwise potential, external costs. For example, a Section 10 permit would be required for any structure. One would surmise that a permit would not be provided by the ACOE if issuance of the permit would significantly impact EFH (under the Magnuson Stevens Fishery Conservation and Management Act, a federal agency must consult with the Secretary if an adverse impact on EFH is anticipated (Welles, 2005)." Similarly, since "[s]ection 10 of the RHA also prohibits 'the creation of any obstruction" to navigation within state and federal waters (Welles, 2005)," one can surmise that external costs to shipping would be minimal[117].

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114 As noted in section 6.1, "[a]quaculture in general has received growing criticism due to past and potential environmental effects associated with aquaculture. " To the extent that the welfare of various members of society would fall as a result of offshore aquaculture, the amount that they would be willing to pay to prevent this industry would be considered an external cost.

115 If private aquaculture ventures pay for all costs associated with the government administering and enforcing the program, these costs will be internalized and, hence, considered private in nature.

116 One could justifiably question, the extent to which offshore aquaculture will displace other beneficial uses of the resource. To a large degree, displacement will depend on the number and average size of operations that would ultimately be forthcoming; both of which are currently unknown. Hawaii has a fledgling offshore aquaculture industry with three operations with leases totaling 193 acres (Marine Aquaculture Task Force Report, 2007). This indicates an average of 64 acres per operation. Based on the assumption that operations in the Gulf would be of similar size, 50 operations would cover less than 4,000 acres.

117 Furthermore, under Action 6 (Designate Sites or Areas for Aquaculture), Alternatives 3 and 4 *(Do not establish marine aquaculture areas, but establish criteria for siting marine aquaculture facilities),* criteria for placement are to be established. Selection of Alternative 4 (which is currently the preferred alternative), will incorporate many criteria that will certainly reduce external costs associated with displacement and habitat degradation (e.g., facility should not be located near coral reefs or hardbottom areas, facility site should not conflict with traditional highly fished areas, etc).

Another external cost relates to environmental and other risks associated with offshore aquaculture operations (Bunsick, 2003)[118].

Additionally, there may exist non-use values associated with the ocean space (e.g., sightseeing or other aesthetics experienced by passengers of recreational/cruise trips) that might be diminished if offshore aquaculture facilities are established. Diminishment in these non-use values would be considered an additional external cost that needs to be considered. Finally, some members of society may be opposed to offshore aquaculture for unstated reasons. If they are willing and able to express this opposition via "willingness to pay"[119] to avoid offshore aquaculture, their opposition, expressed on a monetary basis, would reflect an additional external costs to society associated with offshore aquaculture systems[120].

Consistent with discussion by the Marine Policy Center, there will undoubtedly be some external costs associated with Gulf of Mexico offshore aquaculture (assuming it is economically viable). As such, the issue of compensation to society for the use of a scare natural resource becomes relevant. Compensation for the use of natural resources held in public trust is generally in the form of fees and/or royalty payments (i.e., rent payments)[121]. As noted by the Marine Policy Center (2001), "…one might conceptualize rent payments as compensation for lost opportunities to use the ocean in other ways (p. 59)." These rent payments (i.e., royalties) would, of course, increase in relation to the displacement of other beneficial uses of the resource. A public bid for the right to use the ocean space would guarantee that it is being put to the highest and best use, thus achieving economic efficiency (where economic efficiency implies the maximization of net benefits to society)[122]. The recently reauthorized MSFCMA, however, allows only the recovery of administration fees suggesting any attempt to achieve economic efficiency via a bidding

118 The costs associated with risk reflect the amount that society would pay, under condition of perfect information, in order to drive risk to zero (i.e., certainty equivalence).

119 The differences between "willingness to pay" to avoid placement of offshore aquaculture facilities and "willingness to accept" to allow them to be placed is an important distinction. In essence, whether "willingness to pay" or "willingness to accept" is the appropriate vehicle depends upon who has the rights (see Freeman 2003). For concreteness, Freeman (2003) uses an example of a landfill that is to be located in a particular neighborhood. As Freeman (2003) states, if "…it is accepted that the neighbors have a right to an undisturbed neighborhood…[then the] appropriate measure of the gain to those who would use the landfill would be their willingness to pay to locate it in this neighborhood…" Freeman (2003) goes on to state that "[a]lternatively, if it is argued that the larger society has a right to locate the landfill anywhere, then what is relevant is the neighbors' willingness to pay to keep it out their neighborhood (sic)." In the context of offshore aquaculture, the issue is whether those opposed to offshore aquaculture have a right not to have offshore aquaculture. Given the fact that offshore aquaculture is currently permitted under the EFP process and that the Council has the latitude to develop the regulatory procedure for allowing offshore aquaculture, willingness to pay appears to be the appropriate measure.

120 One might be able to argue, however, that some of the opposition is the result of imperfect information being received by this group. This itself represents a market failure. With more reliable information, opposition may be reduced as would "willingness to pay" to avoid placement of these aquaculture facilities.

121 Fees, in theory, could be based on the size and/or quality of the offshore site. Royalties would be based on revenues.

122 This statement, of course, assumes a competitive bid market as well as zero (or at least equal) external costs (and benefits) associated with alternative uses.

system is moot[123]. Furthermore, there is no mechanism in the National Offshore Aquaculture Act of 2007 (HR2010) does not specify whether the fees could exceed administration costs[124].

Economic efficiency can also be achieved if property rights are established that are both enforceable and freely transferable. The establishment of property rights for a public resource, however, has historically been met with opposition since full property rights would imply the transfer of a public resource to private interests without the public (i.e., the owners of the resource) being compensated[125]. In lieu of the establishment of full property rights, what is being given by the government to private interests in the case of open ocean aquaculture is the right to use a particular location for aquaculture[126].

The Council is considering issuing permits for a given duration of time. A single policy objective of economic efficiency is, of course, likely to be unrealistic and may rank relatively low among the priorities of the Council. The optimal permit duration (i.e., effectiveness), however, depends upon the Council's objective(s) associated with this Amendment. The primary purpose of this Amendment is "… to develop a regional permitting process for regulating and promoting environmentally sound and economically sustainable aquaculture in the EEZ (p.4)." According to the National Offshore Aquaculture Act, it is the policy of the United States to "[e]stablish a permitting process for aquaculture in the Exclusive Economic Zone to encourage private investment in aquaculture operations…" From this viewpoint, the issue of comparing between alternatives is simply one examining how the different alternatives encourage (discourage) private investment. However, actions that could be taken to encourage private investment in aquaculture operations may, in some instances, detract from net benefits. These issues are addressed with respect to each of the alternatives.

Alternative 1: No action (status quo). Exempted Fishing Permits are effective for no longer than one year unless otherwise specified in the EFP or a superseding notice or regulation.

Under the No Action or status quo alternative (**Alternative 1**), the permit will expire after one year, unless otherwise noted. Given the uncertainty of renewal of the permit under this alternative, entrepreneurs are unlikely to invest and lending institutions are unlikely to finance offshore operations.127 It is thus clear that this alternative will not achieve the stated purpose of

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123 In addition, many, if not most, of the beneficial uses associated with ocean space are not covered under the Magnuson-Stevens Act.

124 This Act may be of little relevance to the current analysis since Congress has yet to take action on it.

125 As discussed in more detail below, the issue of permit transferability has not been addressed by the Council. In the absence of any transferability provisions, one would anticipate investment less than what would otherwise be the case, holding all other factors (e.g., duration of permit and allowable species) constant.

126 As noted by Bunsick (2003), rather than granting a right to a particular location, the "…right could be conveyed in such a way as to permit an operation to use a particular amount of ocean space within a much larger area, to permit an operation to periodically relocate (analogous to crop rotation in land-based agriculture), or even permit a totally mobile operation (p.2)." Members of the Louisiana oyster industry, for example, claim to lease water bottoms in many different bays as a means of protecting themselves against the vagrancies of shifting environmental conditions (e.g., salinity conditions). As environmental conditions change, they will then alter harvesting practices. Providing a larger area, as discussed by Bunsick (2003), may provide offshore operators a means to manage their individual operations more effectively under uncertain environmental conditions.

127 Certainly, the lack or security of tenure associated with having to submit for a new permit each and every year adds uncertainty to any quasi-property right regime. Given the high upfront costs and the relatively long period of

the Amendment (as modified based on the National Offshore Aquaculture Act of 2007)[128]. Given that this is the status quo situation, however, Net National Benefits, as measured by combined producer, consumer, and third party surplus, are expected to remain unchanged if this alternative is selected. As discussed below, however, unless there are substantial external costs associated with offshore aquaculture operations (i.e., opportunity costs associated with displacement of other activities, risk, etc.) for which society is not being compensated, higher Net National Benefits could be achieved with longer tenure duration[129].

What are the opportunity costs of displaced alternatives? As mentioned, the potential alternatives vary, ranging from commercial and recreational fishing to mineral extraction[130]. Yet, the Gulf of Mexico is large, encompassing some 3.9 million square kilometers[131]. The largest industry indirectly supported by the Gulf ecosystem (in terms of space used for (semi)permanent infrastructure is the oil-and-gas industry, Currently, there are approximately 4,200 active leases in water depths in excess of 1,000 feet and of this total, 750 are in water depths of 7,500 feet or more (Richardson et al., 2004). These structures, as reported in Section 6.1, occupy but a small fraction of the Gulf of Mexico (0.00025 percent)[132] and conflicts between competing interests are apparently manageable.[133]

It seems reasonable to assume that the number of offshore aquaculture facilities, even if highly profitable, is not likely to approach that of oil-and-gas structures and that the size of the aquaculture facilities are likely to be less than many of the larger oil-and-gas structures[134]. Hence, one is left with the conclusion that opportunity costs to society from offshore aquaculture facilities may be relatively small and can be reduced based on adoption of other actions in this Amendment[135]. This conclusion, however, is highly speculative given all the uncertainties associated with this yet-to-be developed industry[136].

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time needed to realize a profit, one might expect that only those with a risk taking utility function would apply for permits under this management regime. One might also argue that the paucity of requests for EFP permits for the purposes of offshore aquaculture might reflect prevailing uncertainty regarding whether the permits will be renewed. Finally, the fact that NOAA is proposing a regulatory framework to help establish a offshore aquaculture industry (most permits would be for twenty years with renewal of up to twenty years) provides a rather convincing argument that NOAA is under the impression that the EFP process is unsuitable.

128 One qualification to this conclusion is warranted. If longer-term permits are routinely provided (e.g., ten years) then Alternative 1 is equivalent to Alternative 2.

129 This finding, of course, is premised on the hypothesis that offshore aquaculture would be profitable under the appropriate institutional and regulatory framework.

130 Bunsick (2003) provides a more detailed listing of potential other uses. As previously mentioned, however, if Action 6, Alternative 3 (currently the preferred alternative) is adopted, many of the opportunity costs associated with displaced alternatives will be driven down and may approach zero.

131 An unknown, but perhaps large, percentage of this total is not in the U.S. EEZ.

132 If only the northern Gulf were to be considered, however, the percentage would be significantly higher.

133 In fact, the larger concern appears to be associated with the removal of oil-and-gas structures and the impact that removal has on recreational (and possibly commercial) fishing activities. This concern led to the development of the Louisiana Artificial Reef Plan whereby obsolete oil-and-gas structures could be sunk in designated sites.

134 Some of the offshore aquaculture facilities may, in fact, be converted oil-and-gas platforms. A detailed discussion of the potential uses of obsolete oil-and-gas platforms in offshore aquaculture production can be found in Kolian and Sammarco (2005).

135 Valderrama and Anderson (2006) report that "…the siting of an experimental aquaculture growout facility for sea scallops off the coast of Martha's Vineyard, MA, found strong opposition from local commercial fishermen who argued that the proposed location would hamper lobster fishery activities (p. 23)." Details can be found in Westport Scalloping Corporation (1998). Opposition in the Gulf may also be strong. As discussed in Federal

Preferred* Alternative 2: *Aquaculture permits are effective for:

a) 5 years

Preferred b) 10 years and may be renewed in 5 year increments

c) 20 years

d) indefinitely

Under **Alternative 2**, the range of options varies from 5 years to 20 years with one additional option of an indefinite period[137]. Five years (i.e., **Alternative 2(a)**) of investment for some species is likely to be too short to realize a positive return on investment associated with the production of slower growing species. Hence, it would likely limit grow-out options available to entrepreneurs. The entrepreneur, furthermore, when making a determination whether to invest in offshore aquaculture, must weigh the expected return from offshore aquaculture investment with the expected return from alternative investment opportunities. While a 5-year timeframe may be sufficient to realize a positive return on investment, the return may be relatively low due to the high upfront (i.e., sunk) costs that would need to be recovered within a relatively short period. Given this to be the case, higher returns are likely to be achieved elsewhere. Furthermore, a 5-year permit effectiveness, even if profitable, will surely stifle any investment in new technology. As such, limiting the permit duration to 5 years is unlikely to achieve the purpose of this amendment. Unless external costs and/or administrative costs are high relative to the benefits, one can conclude that a longer duration will provide higher net benefits to society (assuming that long-run profitability would be forthcoming).

At this stage of the planning process, it is difficult to identify, much less quantify, external costs at this stage. These costs will depend on a large number of factors, including the number of facilities that come into operation over time; potentially related to the outcome of this amendment. Furthermore, external costs are likely to depend upon the options selected throughout this amendment. For example, designating sites for aquaculture facilities may reduce external costs if there are areas in the Gulf that are highly valued for other uses. Similarly, limiting the species that can be raised may, as indicated later (Action 4) reduce external costs[138]. As previously indicated, however, many of the external costs appear to be somewhat limited, given oil-and-gas structures as a basis for comparison.

Register: December 23, 2003 (Volume 68, Number 246)], "Florida Offshore Aquaculture, Inc., requested an EFP to determine the feasibility of raising fish in the exclusive economic zone approximately 33 miles (53 km) WSW. of Johns Pass, FL." The Federal Register further states that "[d]uring the public comment period, 340 individuals opposed the granting of the EFP. In
addition, one shrimp firm opposed the EFP because it would disrupt their operations. " To some extent, the wide opposition may reflect the proposed siting location. Siting locations in the Northern Gulf, where juxtaposition of oil activities and other Gulf-based activities are more established, opposition may have been less.

136 As section 2.2 of this Amendment suggests, "...Up to 50 future aquaculture operations in the Gulf of Mexico over the next five years" may be considered a reasonable number.

137 For purposes of comparing the different permit durations it is implicitly being assumed that the permits are not renewable.

138 As discussed later, the issue of whether the facility is removed when the operation terminates must also be figured into any estimation of external costs.

Under **Alternative 2(b)**, permit effectiveness would be for 10 years. This option, along with 5-year renewal increments, was proposed in The National Offshore Aquaculture Act of 2005[139]. The revised 2007 version of the Act proposes 20 year permits with up to 20 year renewals. **Alternative 2(c),** is similar to **Alternative 2(b)** with the difference being that the duration would be for 20 years. Based upon the options proposed by the Council, it is implicitly assumed that renewals and/or transfers will not be permitted.

Increasing the duration of the permit will allow for sunk costs to be spread out over a longer time period implying lower fixed costs per year of operation. Hence, the return on investment over the duration of the permit will be enhanced. As such, **Alternative 2(c)** will is preferable to **Alternative 2(b)** in achieving the purpose of this amendment.

Whether Net National Benefits are higher under **Alternative 2(b)** or **Alternative 2(c)** depends upon several factors. Assuming offshore operations are profitable (i.e., encouraging investment), producer surplus will be higher under **Alternative 2(c)** than under **Alternative 2(b).** Similarly, one can assume that consumer surplus under a 20-year duration exceeds that of a 10-year duration. Hence, excluding external and administrative costs, the conclusion can be made that higher net benefits will be forthcoming under **Alternative 2(c)** or **Alternative 2(b).**

Under **Alternative 2(d)**, permit effectiveness would be 'indefinite.' If permit applicants consider this term to infer a (semi)permanent permit, it would begin to mimic the dimensions of pure property rights, though the rights would be relatively weak in nature[140]. As inferred property rights are strengthened with duration, expected investment will be enhanced. This represents not only upfront investment, but also long-term investment. With any limited duration permit, at some point entrepreneurs will begin to draw down fixed capital (i.e., depreciation) rather than reinvesting in capital. Similarly, permits of a fixed duration are likely to inhibit investment in new technology with a strong negative relationship between investment in new technology and the duration of the permit. Hence, this alternative will generate the greatest private investment, assuming that permit applicants interpret 'indefinite' to imply permanent, in the absence of revocation for cause. In the absence of significant external costs, this option would also likely provide the greatest Net National Benefits.

Discussion: Overall, the preceding discussion would tend to suggest that unless external costs are high, benefits and economic efficiency would be enhanced as the permit duration is increased. If external costs are high relative to benefits, however, one would likely conclude that any permit duration that is of a sufficient length to encourage investment would result in a decrease in Net National Benefits. While it is difficult to even qualitatively assess all external

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139 This is also the recommendation of Cicin-Sain et al. (2005). According to the authors "[a] lease of ten years, renewable every five years, would, in our views, provide an appropriate balance." The authors, however, provide little rationale for this conclusion.

140 For example, strong property rights would allow transfer of property by act of sale or donation from one owner to another. As noted by Hoagland et al. (2003) "[i]n general, the more weak are the rights, in terms of shortness of tenure, geographic limits, difficulty of transfer to other parties, potential of revocation, work or performance requirements… the more risky it becomes for the aquaculture entrepreneur. The reason for increased risk is that such restrictions decrease the flexibility of the entrepreneur to respond to the inevitable, but difficult to foresee, environmental and market considerations. Costs associated with these risks will reduce the size of the resource rent, making it less likely that the access system can be characterized as efficient (p. 35)."

costs much less quantify them, the conclusion was reached in this section that they may be relatively limited, though this conclusion is reached with a number of caveats. If correct, however, the implication would be that economic efficiency would be enhanced with extension of the permit duration.

While not considered in any of the alternatives, it can be stated with certainty that developing a system that provides a mechanism for transfer of permits to other responsible parties would enhance efficiency. If the permit duration is of a sufficient length, furthermore, allowing transfers would enhance long-term investment in the aquaculture facility (as opposed to upfront investment). This aspect may be particularly relevant given rapidly evolving technology in the offshore aquaculture business world.

While the analysis to this juncture tends to argue for a more extended permit duration, that conclusion is reached on what can best be described as a "static" evaluation of external costs. Specifically, current external costs are believed to be relatively minor and the assumption is implicitly made that they will remain minor in the future. While it may be belaboring on the obvious, it is impossible to predict what the demand for ocean space will be in the distant future. A long permit tenure system may tend to "lock in" in system which, if found to be lacking, would be difficult to revoke.

Finally, one must consider the Public Trust Doctrine. As noted by Cicin-Sain et al. (2005), while the "[a]pplication of the public trust doctrine does not preclude the government from granting the right to use public resources to a private individual or entity …[i]t does, however, obligate the government to manage these public resources for the greatest benefit of all (p. 44)." Given the long-term uncertainties discussed throughout this option, one possible tradeoff between encouraging investment and the application of the public trust doctrine may be to provide a limited duration with a provision for renewal[141]. The Offshore Aquaculture Act of 2007 has such as provision, but it provides for a 20-year permit with up to 20 year renewals.[142]

7.5.3 Permit Conditions

NOAA Fisheries Service is considering requiring that certain requirements be met in order to qualify for a permit. These requirements generally fall into two categories: (a) an assurance bond to guarantee removal of structures when the permit expires and (b) information that potential investors would need to provide to NOAA Fisheries Service prior to receiving a permit. The economic impacts associated with these issues are considered here.

Alternative 1: Status Quo. Do not specify permit conditions

In examining the impacts associated with **Action 3 (Alternative 1)**, it is important to place it in context with the alternatives associated with **Action 1**. If Action 1, **Alternative 1** is selected,

141 Language would need to be given that, in the absence of negative findings or significant changes in demand for ocean space, renewal is anticipated.
142 This bill associated with this Act (HR 2010) was introduced by Senators Stevens and Inouye but did not make it out of committee. The more recent 2007 National Offshore Aquaculture Act, which was transmitted to Congress on March 12, also stipulates a limited duration with a provision for renewal.

then Action 3, **Alternative 1** is equivalent to Action 3, **Alternative 2**. This is because Action 1, **Alternative 1** would require an Exempted Fishing Permit for conducting offshore aquaculture operations. Hence, while Action 3, **Alternative 1** does not directly specify permit conditions, they are specified in the EFP process.

However, if either **Alternative 2** (require a NOAA Fisheries Service permit to operate a marine aquaculture facility in the Gulf EEZ) or **Alternative 3** (require separate siting and operating permits for an aquaculture facility in the Gulf of Mexico EEZ) associated with Action 1 is selected, then **Alternative 1** (Action 3) can require more or less information than that which would be required under **Alternative 2** (Action 3) or **Alternative 3** (Action 3). Furthermore, under Action 3 (**Alternative 1**), if the EFP permit is selected as the preferred alternative in Action 1 then Action 3, **Alternative 1** may be incompatible with the preferred Action 1 alternative[143].

For purposes of analysis, it is assumed that requested information will be a minimum (e.g., name, telephone number).[144] With this limited amount of information, NOAA Fisheries Service will be unable to assess the potential impacts of the proposed facility on the surrounding environment. With this limited amount of information, furthermore, there would be no assurance that the facility has the appropriate measures in place if a problem were to arise (e.g., disease outbreak). Third, the lack of information will hinder enforcement activities that might be necessary to ensure the safety of the numerous parties dependent upon the Gulf's resources (and society at large). Enforcement of these facilities is paramount and any action that would detract from enforcement capabilities could potentially represent a large cost to society. Finally, the information collected under this alternative will be insufficient for the members of the public to reach rational conclusions regarding whether or not they wish to oppose the permitting of specific facilities.

In general, one can conclude that the costs to potential offshore aquaculture business ventures under the status quo (**Alternative 1**) will be a minimum. Administrative costs will also be minimal. While private and administrative costs will be a minimum, costs to society are potentially large. Finally, benefits associated with collecting the 'barebone' minimum amount of information is, for all intents and purposes, zero.

Alternative 2: Require the Exempted Fishing Permit conditions as specified at 50 CFR 600.745(b) (3) (v)

As specified at 50 CFR 600.745(b) (3) (v):

> The Regional Administrator or Director may attach terms and conditions to the EFP consistent with the purpose of the exempted fishing, including, but not limited to: (A) The maximum amount of each regulated species that can be harvested and landed during the term of the EFP, (B) The number, size(s), name(s), and identification number(s) of the vessel(s) authorized to conduct fishing activities under the EFP. (C) The time(s) and

143 The qualifier "maybe" is used because information requirements under Action 3, Alternative 1, as yet, are unspecified. They could, in theory, be equivalent to EFP requirements (Action 3, Alternative 2).
144 This assumption was made based on pers. Com with Dr. Stephen Holiman, NMFS.

places where exempted fishing may be conducted. (D) The type, size, and amount of gear that may be used by each vessel operated under the EFP. (E) The condition that observers, a vessel monitoring system, or other electronic equipment be carried on board vessels operated under an EFP, and any necessary conditions, such as pre-deployment notification requirements. (F) Reasonable data reporting requirements. (G) Other conditions as may be necessary to assure compliance with the purposes of the EFP, consistent with the objectives of the FMP and other applicable law. (H) Provisions for public release of data obtained under the EFP that are consistent with NOAA confidentiality of statistics procedures at (*sic*) set out in subpart E. An applicant may be required to waive the right to confidentiality of information gathered while conducting exempted fishing as a condition of an EFP.

Information requirements under this alternative, as indicated, are considerably more (and more explicitly stated) than the assumed information requirements under **Alternative 1**. Since 50 CFR 600.745(b) (3) (v) allows the Regional Administrator or the Director "[r]easonable data reporting requirements" (subparagraph F), NOAA Fisheries Service still maintains considerable latitude regarding what information it can request from the applicants. To protect the marine environment and to facilitate enforcement, one would expect that "reasonable data requirements" requested by the Regional Administrator or his designee would closely "mirror" those stated in **Alternative 3(b)** of this Action[145]. Hence, with some minor distinctions (discussed in Association with **Alternative 3(b)**, one would expect little differences in the discussion of benefits and costs associated with **Alternative 2** and **Alternative 3(b)**.

Preferred Alternative 3: Establish the following permit conditions:

- **a) Obtain an assurance bond for the removal of aquaculture structures as a condition of permit issuance. NOAA Fisheries Service will develop a mechanism for requiring a bond, as appropriate.**
- **b) Describe plans for the following:**
  - **i. Limit genetic impacts on wild Gulf stocks. Required components of the plan would include: 1) the source of brood fish for fingerling production by geographic area, 2) the frequency brood stock are replaced, 3) and whether any cultured fish will be raised to sexual maturity.**
  - **ii. Aquatic animal health management. Required components of the aquatic health management plan would include: 1) identification of an animal health management expert and frequency of visits, 2) procedures for notifying NOAA of reportable disease, 3) procedures for prestocking health inspections of aquatic animals, and 4) freezing or refrigerating diseased animals so they are available for inspection. "Diseased" animals are those infested with parasites and/or infected by bacteria or virus.**
  - **iii. Collecting and spawning broodstock and rearing fingerlings. Required components of the plan would include: 1) a description of the culture facility, if spawning and rearing activities will occur at a location other than the culture facility; 2) the number species, and size**

145 As discussed below, all information requirements associated with Alternative 3.b appear "reasonable."

of brood fish proposed to be captured and the methods/gears used for capturing, holding, and transporting broodstock; 3) anticipated size to which fingerlings will be raised; and 4) a list of names and addresses for spawning and rearing facilities used to obtain fingerlings and any relevant aquaculture permit numbers.

iv. Environmental monitoring. Required components of the plan would include: 1) a plan for interactions with threatened or endangered species, 2) a description of how environmental impacts would be monitored, and 3) compliance with EPA standards.

v. Emergency disaster plan for hurricanes, net or cage failure/escapement, or pollution event.

c) Improve law enforcement capabilities. Components would include: 1) Any vessel authorized for use in aquaculture operations must have an aquaculture permit onboard, 2) notification of the time, date, and port of landing must be given to law enforcement at least 3 hours prior to landing, 3) a record of the number of fish raised for aquaculture (number of fingerlings placed in growout for market) must be maintained, 4) require submission of fin clips from broodstock used in spawning of fingerlings.

d) A use it or lose it provision for permits based on development of operations within 2 years of issuance of the permit. Development of operations is considered to be occurring when aquaculture equipment is obtained and placed in the water

e) Other permit conditions:

i. Applicant must provide names, addresses and phone numbers of captains and vessel owners, along with project vessel(s) documentation or identification numbers. As a condition for maintaining the permit the applicant agrees to notify NOAA Fisheries Service if there are any changes in company owners, captains and/or vessel owners;

ii. Applicant must describe the exact location of the facilities and any associated pens or enclosures using GPS coordinates and the species of fish to be cultured;

iii. Applicant must agree to maintain a minimum of one locating device on each pen or enclosure and immediately notify NOAA Fisheries Service in the event the pen or any retention aquaculture enclosure is lost at sea;

iv. Permittee must describe the harvesting equipment necessary for operation and removal of aquaculture fish;

v. The aquaculture operational permit shall specify the conditions under which aquaculture harvesting gear or any type of fishing equipment shall be deployed, retrieved, and stored;

vi. Permittee must notify NOAA Fisheries Service prior to removal and transport of aquaculture fish from the facility to shore;

vii. Aquacultured fish must be maintained with heads and fins intact until reaching the processing facility.

viii. Transport and service vessels, aircraft, and vehicles must have a copy of the aquaculture permit on board; and,

ix. The possession of any wild fish aboard any marine aquaculture facilities and/or its transport and service vessels, vehicles, or aircraft is prohibited.

f) Other appropriate permit conditions, as specified by the NOAA Fisheries Service Regional Administrator, necessary for issuance and administration of an aquaculture permit.

Alternative 3(a) would require an assurance bond to ensure removal of aquaculture structures when an operation terminates[146]. The use of assurance bonds has been discussed as a reasonable tool for ensuring the costs of environmental damage are covered by the persons that create the damage (Mathis, 2002 and Productivity Commission, 2004). Assurance bonds have also been used to ensure the removal of offshore oil and gas platforms in the Gulf. A study of using these platforms for marine aquaculture stated that removal bonds for major structures in Federal waters start at $100,000 per year and can cost as much as $4 million per year (LUMCON, 2005). Two issues need to be considered here with regard to assurance bonds. First, what are the impacts of this requirement on economic efficiency (net national benefits)? Second, what are the impacts of this requirement on investment?

With respect to the impact that **Alternative 3(a)** has on economic efficiency, it is first useful to address the question whether removal (via payment by either the private sector or the government) enhances net national benefits. There are costs associated with removal (i.e. the use of scarce resources). For oil-and-gas platforms, these costs can be significant. These need to be compared to the benefits of removal. The benefits, of course, represent the reduction in external costs to society that are likely to continue after the aquaculture operation terminates[147]. One of the larger benefits may relate to safety considerations of vessels shrimping or traversing through the area.

As previously stated, it is difficult to infer these costs on a qualitative basis, much less attempt to quantify them. Furthermore, as noted, they are likely to be a function of subsequent actions considered in this amendment[148]. Overall, however, there appears to be no evidence that the benefits associated with removal exceed the costs though likewise, there is no evidence that the costs exceed the benefits.

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146 In the absence of the passage of The National Offshore Aquaculture Act of 2007, there is some question whether the NMFS would legally be able to require this bond. Certainly, costs of removal of the structures goes well beyond recovering administrative costs.

147 One way to conceptualize this issue is by considering the amount of money society would be willing to pay (under perfect information) for removal of these structures vis-à-vis the actual removal costs. If the removal costs exceed what society is willing to pay, one can conclude that there is a loss in net national benefits associated with removal.

148 In the extreme, if there were no other beneficial uses of the ocean space, benefits to society associated with removal of the structures would be zero.

Even if the costs of removing offshore structures at termination exceed the benefits, there may be valid reasons for removing them when operations terminate.[149] The removal process, of course, could be conducted under contract by the aquaculture firm (i.e., the aquaculture firm is responsible for their removal) or contract by the government (i.e., the government is responsible for their removal). The requirement of an assurance bond prior to initiation of offshore operations, forces the firm to internalize these costs in its decision-making calculus. In other words, it would treat removal costs as little more than an additional upfront cost. If the firm terminates operation and leaves without removing the structure, the funds have already been provided to the government (i.e., the assurance bond) for the government to use in the removal process.

If there is a clear desire for operations to remove structures upon termination, the use of assurance bonds may also be a cost-effective means of accomplishing this goal (and, in fact, the only means). First, in the absence of an assurance bond, it may be difficult to recover the needed monies for removal if the company enters bankruptcy. Second, even if highly profitable with sufficient capital to remove the structures upon termination, some firms may choose not to do so. This would require litigation which can be both expensive and lengthy. Obligation of an assurance bond may be less costly, therefore, than litigation.

Members of the aquaculture industry have indicated that assurance bonds for this specific activity are currently not marketed. However, if the regulation is passed and a demand for these bonds is created, it is anticipated they will be available. Because persons are currently not using these bonds, their cost is not known. If the cost of these bonds includes the removal of structures like oil and gas platforms, the cost of the bonds could prohibit the success of offshore aquaculture on those platforms (Kolian and Sammarco, 2005). If the cost of removing pens and other infrastructure installed by the aquaculture firm (not the oil platform) is all that the bond must cover, the cost of the bonds may not be prohibitively expensive.

It is important to recognize, however, that the assurance bond may have little effect on economic efficiency. Specifically, costs to society will be the same whether the firm removes the aquaculture structures (or government does so with assurance bond monies if the firm fails to remove them) or the government pays for removal via general treasury funds. Payment for removal via general treasury funds would merely constitute a transfer payment (i.e., the taxpayers at large paying for removal rather than the operating firm). In essence, payment via appropriated funds would merely represent a subsidy to the operating firms[150]. One potentially strong rationale for having the firms pay for removal, however, is that one can consider it a cost of using a natural resource.

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149 As discussed earlier, economic efficiency is but one factor to be considered in the development of an offshore aquaculture program.

150 Economic efficiency would be different under the alternative scenarios given the fact that the subsidy would encourage more investment (and output) then would otherwise be forthcoming. Greene and Kahn (1997), however, argue for increased subsidies to the aquaculture sector based on the premise that increases in aquacultured output can help to rebuild declining stocks and reduce externalities in capture fisheries. To some extent, the validity of Green and Kahn's argument would depend upon whether offshore aquaculture output merely displaces an equal amount of the perfectly substitutable imported product. If this is the case, one would expect no change in ex-vessel price and, hence, no rebuilding of declining stocks.

Finally, what are the impacts of requiring an assurance bond on investment in offshore aquaculture? The assurance bond, as noted, is a fixed (sunk) cost to the firm. If the firm fulfills its obligation to remove the structures when operations terminate, it will collect the bond. If it defaults on its obligations, the government can use the bond money to remove the structures. In either instance, the costs are internalized by the firm. Given these higher fixed costs, long-run profitability will be reduced. Assuming heterogeneous firms, therefore, the bond requirement will make unprofitable those marginal operations that would otherwise be profitable (i.e., if no assurance bond was required). Hence, one can conclude that requirement of an assurance bond will lead to less investment than would otherwise be forthcoming[151].

Several conclusions can be drawn from this discussion. First, there is insufficient information to determine whether the National Net Benefits would be enhanced by requiring removal of offshore structures when operations terminate[152]. Second, costs to society are unaffected by who removes the structures (government or the business venture). Third, there may be more cost-effective methods for ensuring safety after aquaculture operations are terminated. 153 And finally, one can conclude that any assurance bond requirement is likely to reduce investment.

Alternative 3(b)[154] would require those investors seeking an offshore aquaculture permit to provide NOAA Fisheries Service with a set of plans for addressing or monitoring certain environmental conditions so that adverse conditions can be prevented. All items listed in **Alternative 3(b)** (i.e., items *i* through *v*) will have to be considered and included in any "good" business plan. Hence, the cost of providing this information to NOAA Fisheries Service may be minimal. While there will be some administrative costs associated with processing the relevant information, these costs should also be nominal relative to start-up costs or annual operating costs.

The benefits to society of NOAA Fisheries Service having this information are large. First, it will allow NOAA Fisheries Service to more fully assess the potential impacts of the proposed facility on the surrounding environment. Second, it will help to ensure that the facility has the appropriate measures in place should any problems arise. Third, it will facilitate enforcement associated with the proposed activities. Finally, assuming the information provided to NOAA Fisheries Service is not proprietary in nature, members of the public will be able to obtain

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151 The argument has been made that (currently) there exists no available mechanism for securing the finances needed for these bonds. This appears to be a relatively weak argument in that supply will be forthcoming if there is sufficient demand. The fact that no market currently exists simply implies that there is little or no demand under the current regulatory regime.

152 If they are not removed, however, then one must consider the external cost associated with not removing them (i.e, the external costs to society after aquaculture operations have ceased) in the efficient duration length. If external costs after operations cease are relatively high, one might reach the conclusion that the costs to society of offshore aquaculture exceeds the benefits.

153 For example, assume the primary rationale for requiring structure removal is that of safety. If offshore aquaculture is highly successful, a support industry could be developed that would ensure that the obsolete sites remained lighted over time. This would require the offshore firm to deposit sufficient funds into an account that the interest from these funds could be used in perpetuity by the support industry for lighting purposes.

154 Note that if Action 1, Alternative 2 is selected as the preferred alternative, then the information requested under Action 3, Alternative 3.b may be incompatible with the preferred Alternative selected under Action 1. Since the phrase "reasonable data requirement" is included in 50 CFR 600.745(b) (3) (v), however, one cannot necessarily conclude that they are incompatible.

valuable information from which will allow them to make more informed judgments regarding external benefits and costs of the proposed facility. This, hopefully, will result in more rational discussion in the public hearing process of the application.

In general, one can conclude that the benefits associated with adopting 3.b exceed the costs by a significant margin. The benefits associated with **Alternative 3(b)** far exceed those of the status quo (**Alternative 1**) under the assumption that data requirements under the status quo would be minimal. While one could anticipate that information requirements specified in **Alternative 2** would mirror those in Alternative 3.b, the later alternative has the benefit that the information request is explicitly stated. Thus, potential investors will know what information will be required as they are developing their business perspectives. Since costs under any of the scenarios will be minor, one can conclude that Net National Benefits of **Alternative 3(b)** are significantly greater than those of the status quo and are likely to be marginally higher than those associated with **Alterative 2**.

The intent of the elements in **Alternative 3(c)** is to improve law enforcement's ability to efficiently and effectively monitor offshore aquaculture production. Under **Action 3, Alternative 3(c)(1)** would require that any vessel used in the aquaculture operation have an aquaculture permit on board the vessel. Requiring the permit to be onboard allows enforcement personal to identify the firms that are associated with the harvest or supplies onboard the vessel. Linking the vessel with a specific firm should enable the enforcement officers to more easily determine whether the vessel is in compliance with both aquaculture and wild stock harvest requirements. Simplifying the process to link the activities of a vessel with aquaculture activities should reduce overall enforcement costs.

Alternative 3(c)(2) would require that the aquaculture firm notify law enforcement of the time, date, and port of landing at least 3 hours prior to landing. The advance notice of landing provides enforcement staff with a warning that a landing is eminent and allows staff to target specific vessels for data-gathering and enforcement needs. Implementing this requirement would improve enforcement's ability to effectively observe offloads and gather biological data from specific vessels. If operators did not provide a location of landing it may be difficult for enforcement staff to observe landings and offloads from specific vessels in areas with several offloading sites.

A notice of offload requirement is thought to provide a deterrent to circumventing harvest restrictions by providing enforcement personnel with the ability to target specific vessels and prepare enforcement prior to a vessel landing. Limiting the notice time to only 3 hours should provide aquaculture operators sufficient time to plan their harvests and notify enforcement of the port of landing. In the Alaska IFQ program for halibut and sablefish, the notification requirement was originally 6 hours prior to landing. That regulation was modified under FMP Amendments 72 for the Bering Sea/Aleutian Islands and 64 for the Gulf of Alaska. Reducing the landing notification was projected to improve efficiency and still provide ample time for enforcement offices to have staff in place to monitor landings.

This alternative does not specify a window when landings could occur. In the Alaska halibut and sablefish IFQ program a window of 6 am to 6 pm is allowed for landings to occur. Limiting when landings could occur reduces the need to have additional enforcement on call during other hours. Minimizing the staff that must be available could reduce the enforcement costs associated

with the program. Not limiting the hours when landings could occur will provide additional flexibility to the aquaculture firms. It may also allow them to time landings to meet the requirements of various fresh markets. If the longer offload window does provide marketing advantages, it would likely increase the ex-vessel price of the fish they are selling by improving market efficiencies that are likely to have an overall beneficial effect on consumers. These benefits are not amenable to further quantification, at present, given available information on costs, earnings, and operational structure within the respective segments of the industry.

Alternative 3(c)(3) would require that the aquaculture business maintain a record of the number of fingerlings that were placed in facility to be raised. By knowing the number of fingerlings that are being raised enforcement could determine whether too many fish are being harvested. Records on the number of fish being raised will provide another mechanism that enforcement could use to track the number of fish a firm should be allowed to harvest from their facility.

The costs incurred by the aquaculture firm to comply with this requirement should be very small. If the firm purchases their fingerlings they will have sale receipts that document the number of fingerlings they purchased. Those sales records could be filed to meet this requirement. If the firm raises their own fingerlings, they would need to count the fingerlings when the are stocked. This would likely be done without the requirement to ensure that the pens are stocked to the proper density to maximize production from the facility. The overall cost of storing the information in either case would be the time and filing supplies to maintain the data. For a six-cage system, these costs155 should not amount to more than $20 per stocking of the cages.

Alternative 3(c)(4) requires the submission of fin clips from broodstock used in spawning of fingerlings. Enforcement could use the fin clips to obtain DNA that could be compared to samples of the fish landed from the facility. This would provide another enforcement measure that could be used to ensure that only fish from the aquaculture facility are being harvested and marketed by the firm.

This alternative does not provide information on the specific methods that must be followed when supplying the fin clips. It is assumed that a standard biologic procedure will be followed to submit the fin clips to enforcement. Kits that are used to store DNA are available from various suppliers over the internet. These kits often cost less than $20. DNA kits proposed to be used by law enforcement offices in Maryland under Senate Bill 486 proposed in 2002 cost $3.5 each (http://mgadls.state.md.us/PDF-Documents/2002rs/fnotes/bil_0006/sb0486.PDF). The cost to store 100 samples for a year was $50 (http://www.analyticalgenetics.ca/pricelist.php). These costs are only provided as examples and the actual cost of collecting and storing the fin clips would likely vary from these estimates. The estimates were only provided to indicate the costs of collection and storage are expected to be relatively small for the number of brood stock that would be needed. For example, if 4 animals were needed for brood stock by a firm, the total cost of complying with this requirement could be less than $20 a year for materials plus the time required prepare the samples and the cost to transport them to the enforcement office. The cost to the government to store the samples could be about $50 per year per 100 brood stock.

155 The cost of six file folders (one per cage), space in a file cabinet, and the time to file the folders. Alternatively the information could be stored on a computer and the overall cost would be even lower.

Alternative 3(d) defines a use it or lose it provision for the aquaculture site. An offshore aquaculture permit, which grants a person the privilege to use a specified site for an aquaculture operation can be considered a tangible asset. In a private market setting, the price of a tangible asset (either sales price or lease price arrangement) will be directly related to its contribution to the output process (i.e., its marginal value product). If sold (leased) within a private market setting, therefore, the price that one would be willing to pay for a permit would relate to its ability to generate profits from other permitted sites.

Since the maximum amount that can be charged for a permit under the Magnuson Stevens Act, however, is limited to administrative costs associated with issuing the permit, one can envision applications for permits in excess of that number intended for near-term use. There are at least three reasons for this. First, an individual/group may apply for a permit with the anticipation of developing an offshore aquaculture operation at some (distant) future point in time (say, after sufficient capital is raised). While there may be benefits to such an action, such actions are likely to be excessive from an economic perspective because the cost of the permit is below its potential contribution to the production process. Furthermore, such an action may displace potential operations that have the required capital and can begin to produce output within a limited period of time.

The second reason why the number of applications may exceed the number intended for near-term use, in the absence of a use it or lose it provision, reflects speculative activities among investors. Specifically, while this amendment does not include a provision for the transfer of permits, some investors may apply for a permit under the premise that the amendment may, at some future point in time, be amended to allow for transfer of permits. At such a point in time, the speculator can, through the sale of the permit, earn the difference between what he is able to sell the permit for (i.e., the marginal value product of the permitted site) and what he paid for the permit (i.e., the application cost).

A final reason why the number of applications may exceed the number intended for near-term use, in the absence of a use it or lose it provision, reflects the fact that some individual/groups may simply be opposed to offshore aquaculture operations and, as such, apply for permits with no intention of using these permits for commercial offshore aquaculture. Rather, the purpose of applying for the permits is to exclude those with the intent of establishing offshore aquaculture facilities from doing so in desired locations (i.e., those locations that would be most conducive to offshore aquaculture operations).

Given the expected positive net national benefits associated with offshore aquaculture, one can conclude that actions limiting the ability of interested entrepreneurs from establishing operations in the near term will result in a reduction in net benefits. Hence, a provision that requires development of operations within two years of issuance of a permit is likely to provide positive benefits to society.

Alternative 3(e) would provide for additional permit conditions. The only options that would increase the costs beyond the typical paperwork requirements are **Alternatives 3(e)(iii)** and **3(e)(vii). Alternative 3(e)(iii)** requires that a minimum of one pen-locating device must be attached to a cage or enclosure. The type and cost of the pen-locating device that would be used by each firm are not known. If a simple system is employed that uses lighted buoys, as required

by the USCG the cost would range from $350 for a simple lighted buoy (Carmanah Model 501) to $1,450 per buoy for a lighted buoy with GPS (Carmanah 702-GPS) before tax and shipping. Because two corners of the pen must be marked the total cost would be approximately $700 to $2,900 per pen. Maintenance cost of the buoy should be relatively inexpensive. The buoys are solar powered and operate using LCD lights that are reported to last about 100,000 hours. The backup batteries are guaranteed for 5 years. Marking the corners of the pens would help persons trying to locate the structures if they are lost and would provide warning markers for passing vessels.

Alternative 3(e)(vii) would require that aquacultured fish be maintained with heads and fins intact until reaching the processing facility. The principal benefit associated with this alternative would be to help enforcement establish whether there is any mixing of wild and aquacultured product.156 To the extent that heading/finning could be conducted offshore in an economically viable manner, however, this alternative is likely to increase costs associated with transporting the fish to any onshore processing facility.157

Alternative 3(e) would provide for additional permit conditions. The only options that would increase the costs beyond the typical paperwork requirements when applying for a permit is **Alternatives 3(e)(iii)** and **3(e)(vii). Alternative 3(e)(iii)** requires that at least one pen-locating device must be attached to a pen or enclosure. The type and cost of the pen-locating device that would be used by each firm are not known. If a simple system is employed that uses lighted buoys, as required by the USCG the cost would range from $350 for a simple lighted buoy (Carmanah Model 501) to $1,450 per buoy for a lighted buoy with GPS (Carmanah 702-GPS) before tax and shipping. Because two corners of the pen must be marked the total cost would be approximately $700 to $2,900 per pen. Maintenance cost of the buoy should be relatively inexpensive. The buoys are solar powered and operate using LCD lights that are reported to last about 100,000 hours. The backup batteries are guaranteed for 5 years. Marking the corners of the pens would help persons trying to locate the structures if they are lost and would provide warning markers for passing vessels.

Additional alternatives contained in **Alternative 3(e)** would largely include simple notification requirements or typical paperwork for obtaining and maintaining a permit. Several of these alternatives would also help to enhance law enforcement. **Alternatives 3(e)(i)** and **3(e)(ii)** would require the aquaculture firm to provide information related to their business and would likely be required on the firms permit application(s). The requested information would be used to update permits. The firm would also be required to notify NOAA Fisheries Service of changes to their business in order to maintain up-to-date permit information on the applicant. If the changes are considered major departures from the original permit, then the firm would likely be required to submit a new permit application so the entire operation could be reviewed. Applying for a new

156 This comment is premised on the assumption that cultured product would be of a relatively uniform size whereas wild catch would be of varying sizes. If this assumption is not valid, there is likely to be little rationale for this requirement. Much of the rationale for this requirement relates to enforceability of minimum sizes associated with the different reef fish species. Since there is no minimum size associated with aquacultured species, justification of this alternative from an enforcement standpoint becomes more tenuous.
157 Presumably, offshore processing facilities operating in conjunction with the rearing system would be permitted in which case this alternative becomes moot.

permit(s) would be more costly than providing a simple notice of change in the operation of the business.

Alternative 3(e)(iv) Alternative 3(e)(v) would merely require the types of harvesting equipment will be used for harvesting the aquacultured product and conditions under which the aquaculture harvesting gear (or other fishing equipment) will be deployed. The costs of providing this information to NOAA Fisheries Service would be negligible yet this information can be used by enforcement to monitor harvesting operations in a cost-effective manner.

The intent associated with requirement specified under**Alternatives 3(e)(vi), 3(e)(viii),** and **3(e)(ix)** is to provide enforcement with information needed to better manage both offshore aquaculture industry and its interaction with the capture industry. **Alternative 3(e)(xi)** would require the permittee to notify NOAA Fisheries Service prior to removal and and aquaculture fish from facility to shore. The cost of providing this information would be negligible yet the information will assist enforcement personnel in ensuring that wild harvest is not being commingled with (or substituted for) aquacultured product.158 Similarly, prohibition of the possession of wild fish aboard any marine aquaculture facility, and its transport and service vessels, vehicle, or aircraft (i.e., **Alternative 3(e)(ix))** will help to deter commingling or substitution of wild product with aquacultured product and costs associated with this Alternative will be negligible.

Alternative 3(f) would merely allow the NOAA Fisheries Service Regional Administrator to impose conditions in addition to those already specified, as deemed appropriate. Without additional information pertaining to what these conditions might be, it is impossible to determine whether this alternative would result in any significant increase in costs. Likewise, benefits are unknown.

7.5.4 Species Allowed for Aquaculture

The Council is considering three alternatives with respect to the species that will be allowed for aquaculture in addition to the status quo. Alternatives under consideration are presented in this section, and to the extent possible, a qualitative discussion of the economic impacts associated with selecting each alternative is provided

Alternative 1: No action (status quo). Do not specify species allowed for aquaculture.

Currently, the only legal avenue for EEZ aquaculture is under an Exempted Fishing Permit, as provided at 50 CFR 600.745. Language of the EFP requires that applicants specify "[t]he species (target and incidental) expected to be harvested under the EFP, the amount(s) of such harvest necessary to conduct the exempted fishing, the arrangements for disposition of all regulated species harvested under the EFP (50 CFR 600.745)." The historical basis for the EFP does not include offshore aquaculture and, hence, there is no language regarding what species

158 It also provides a timeframe from which enforcement can conduct inspection activities.

would be permitted. Hence, the status quo (**Alternative 1**) could include all species whether or not managed by the Gulf Council, non-indigenous species, and genetically modified species[159].

Alternative 2: Allow the aquaculture of all non-genetically modified Gulf of Mexico species in the reef fish, red drum, and coastal migratory pelagics FMPs.

This alternative would allow for the aquaculture of most species managed by the Gulf of Mexico Fishery Management Council but would prohibit genetically modified variations of these species. [160] Four primary species – spiny lobster, stone crab, corals, and shrimp – would be excluded. While one can be relatively certain that there will be no demand for offshore aquaculture of shrimp, one can not be as certain regarding spiny lobster and stone crab. Finally, there currently exists a separte permitting system (outside the EFP) for live rock (i.e, coral). Hence, inclusion or exclusion of coral species in the set of alternatives under this action would not influence the analysis.

Alternative 3: Allow the aquaculture of all non-genetically modified marine species in the Gulf of Mexico managed by the Council, except those species in the shrimp and coral fishery management plans. Harvest or possession of goliath grouper and Nassau grouper is prohibited in the Gulf EEZ.

Alternative 3 is somewhat more flexible than **Alternative 2** in that it would also allow for EEZ aquaculture of spiny lobster and stone crab. However, it would preclude the aquaculture of shrimp species, species in the coral management plan, and goliath and Nassau grouper. One can be relatively certain, as noted, that there will be no demand for offshore aquaculture of shrimp. There could, however, be some demand for rearing goliath and Nassau grouper if harvest and possession were permitted. Prohibition of the possession or harvest of goliath and Nassau grouper would stymie any economic rationale for rearing these species. Species in the coral fishery management plan are excluded because there exists a current permitting process (outside the EFP) process for the rearing and harvest of live rock.

Preferred Alternative 4: Allow the aquaculture of all marine species in the Gulf of Mexico managed by the Council, except those species in the shrimp and coral fishery management plans, and send a letter to NOAA Fisheries Service requesting development of concurrent rulemaking to allow aquaculture of highly migratory species. Do not allow non-native species, transgenic species, or otherwise genetically modified species to be used for aquaculture in the Gulf of Mexico

This alternative would allow for the aquaculture of all marine species managed by the Gulf of Mexico Fishery Management Council, with the exception of species in the shrimp and coral fishery management plans and would request concurrent rulemaking to allow aquaculture of

159 This does not imply that non-indigenous species would be allowed in offshore aquaculture since (a) the Regional Administrator, Director, or his designee has latitude on approving the EFP and (b) the USFWS and NOAA co-chair the federal Aquatic Nuisance Species Task Force established to develop a program to prevent, monitor, control and study aquatic nuisance species, and, therefore, both agencies may, in principle, not favor the use of non-native species for aquaculture.

160 A list of all stocks (and species in the respective management units) can be found in Appendix A of this Amendment)

highly migratory species. Hence, the alternative is more inclusive than **Alternative 3** in that the possession of goliath and Nassau grouper would be permitted and the development of concurrent rulemaking would also permit the aquaculture of highly migratory species.

Of these four alternatives, **Alternative 1** is, at least in theory, most inclusive[161]. It includes all species native to the Gulf of Mexico (including genetically modified variations of these species), as well as non-indigenous species.

For purposes of examining the economic impacts associated with the four alternatives, it is useful to first examine those alternatives that pertain only to native species (i.e., **Alternatives 2-4**). These can then be compared to the status quo (**Alternative 1**) which includes all native species (including genetically modified native species) plus non-native species.

In comparing **Alternative 3** to **Alternative 2**, the first question that needs to be addressed is whether there is any demand by entrepreneurs for growing species in offshore aquaculture facilities that would be allowed under **Alternative 3** but which would not be allowed under **Alternative 2**. If there is no demand (current or near future), one can conclude that both the benefits and the costs associated with adopting **Alternative 3** are identical to those associated with the adoption of **Alternative 2**. If there is a demand, however, one can assume that entrepreneurs believe that profit can be earned from growing species allowed under **Alternative 3** but not **Alternative 2**. In this situation, one can conclude that producer surplus associated with **Alternative 3** would be greater than that associated with **Alternative 2** and that consumer surplus will either remain unchanged or will increase. [162]. Finally, as discussed under Action 2, external costs associated with offshore aquaculture are not anticipated to be excessive. This would be the case independent upon whether **Alternative 2** or **Alternative 3** is adopted.

Hence, one can conclude that the Net National Benefits associated with **Alternative 3** exceed those of **Alternative 2** if there is a demand by entrepreneurs for growing species that would be allowed under **Alternative 3** that would not be allowable under Alternative 2[163]. If there is little or no demand, the Net National Benefits of adopting **Alternative 3** are equivalent to those expected by adopting **Alternative 2**.

Alternative 4, as noted, is more inclusive than **Alternative 3** in that it would allow for aquaculture of all species managed under an FMP (other than species included in the shrimp and

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161 The qualifying term "in theory" is used here because the USFWS and NOAA co-chair the federal Aquatic Nuisance Species Task Force established to develop a program to prevent, monitor, control and study aquatic nuisance species, and, therefore, both agencies may, in principle, not favor the use of non-native species for aquaculture. The Gulf Council's Ad Hoc Aquaculture Advisory Panel is on record of being opposed to the introduction of any non-native species.

162 See Action 2 for a more complete discussion of expected changes in producer and consumer surplus. As noted in reference to that Action, the reduction in producer surplus in the related capture fisheries is expected to be relatively small given the fact that the current management regimes for Council managed fisheries do not attempt to maximize producer surplus. Hence, it is expected that gains in producer surplus from offshore aquaculture facilities will exceed reductions in producer surplus by the fishing sector. In addition, producer surplus in related sectors (e.g., processing) will likely be enhanced.

163 As previously noted, external costs are highly uncertain. If, in fact, they are much larger than what is considered in this analysis, then one would conclude that Net National Benefits of adopting either Alternative 2 or Alternative 3 would be less than zero (i.e., there would be a net loss in welfare to society).

coral fishery management plans) and would request NOAA Fisheries Service to develop concurrent rulemaking that would permit aquaculture of highly migratory species. This option also clearly prevents the introduction of non-native species or transgenic species. The potential biological and environmental costs of introducing those species to the Gulf were thought to outweigh any economic benefits that would be derived from their introduction. Based upon the same line of reasoning used in comparing **Alternative 3** with **Alternative 2**, one can conclude that the Net National Benefits of Adopting **Alternative 4** are at least as high as those of adopting **Alternative 3**. Net Benefits could possibly be higher if there is demand for entrepreneurs to raise goliath grouper, Nassau grouper, or HMS.

As noted, the status quo, potentially, provides the broadest range of species (i.e., both native and non-native species). Since it does not preclude genetically modified native species and/or non-indigenous species , some additional discussion is warranted. Issues/concerns associated with the introduction of genetically modified native species and/or non-indigenous species are covered in Section 6.1. While there are additional risks, we as a society take risks every day. The issue with respect to offshore aquaculture is the potential benefits associated with the introduction of non-native species versus the costs. If there is no demand by entrepreneurs for raising these species in the Gulf, then benefits would be zero and costs would be zero[164]. If there is demand, however, there would likely be benefits in the form of increases in consumer and producer surplus. If some of the concerns regarding the introduction of genetically modified native species and/or non-indigenous species come to fruition, however, external costs could, potentially, be high. In the absence of any information on (a) probability of occurrence of a negative environmental impact (e.g., disease, impact of escapement on carrying capacity and wild stocks, etc.) and (b) the costs to society if this impact were to occur, however, it is impossible to judge whether benefits exceed costs[165]. Hence, it is impossible at this point to compare Net National Benefits under the status quo (**Alternative 1**) with Net National Benefits associated with any of the other alternatives.

7.5.5 Allowable Marine Aquaculture Systems

Action 5 consists of three alternatives and the status quo. **Alternative 2** would allow only cages and net pens in offshore aquaculture. While the verbiage associated with **Alternative 3** is somewhat nebulous in nature, a literal interpretation would tend to imply that any system would be permitted. If this interpretation is correct, Alternative 3 provides a great deal of flexible to the entrepreneur in that no restrictions are placed on the type of aquaculture system that would be allowed. **Alternative 4** does not restrict the types of aquaculture systems that may be used, but explicitly requires NOAA Fisheries Service to review each application to ensure that the system provides environmental safeguards.

Alternative 1: No action (status quo). Do not specify allowable marine aquaculture systems.

164 One might expect that USFWS and NMFS would oppose the introduction of any non-indigenous species in principle.

165 One might surmise that USFWS and NMFS would oppose the introduction of any non-indigenous species unless evidence is overwhelming that the risk of introduction is at "an acceptable level."

Currently, the only legal avenue for EEZ aquaculture is under an Exempted Fishing Permit, as provided for under 50 CFR 600.745. Allowable gears (systems) are not specified in the EFP and, hence, the status quo **(i.e., Alternative 1)** is, presumably, equivalent to **Alternative 3**. Hence, discussion of **Alternative 3** will serve also for the discussion of the status quo.166

Alternative 2: Allow only cages and net pens.

Alternative 3: Allow cages and net pens, and other aquaculture systems, such as systems used for sponges, corals, and bivalve mollusks.[167]

Preferred Alternative 4: To have NOAA Fisheries evaluate each proposed aquaculture system on a case-by-case basis to ensure reliable offshore growing system technology is used to provide environmental safeguards.

Alternative 2 limits the prescribed systems to two types: cages and net pens. **Alternative 3** would, presumably, allow for any system, including non self-contained systems. The full complement of growout systems, given by Cicin-Sain et al. (2005), is as follows (p.14):[168]

Shellfish culture:

(a) Floating longlines or hanging cages or lantern nets;
(b) Free planted –"bottom ranching"
(c) Bottom cages

Finfish culture: Either the conventional rearing of hatchery-reared fingerlings or for "fattening to add value to wild harvest fish (such as tuna). Includes: stationary pens, submersible pens, and possibly mobile floating pens

"Ranching"

Release of juveniles that either return or are "trained" to aggregate for harvest

Seaweed culture

Longlines for aquatic plants

Marine Species

The term means finfish, mollusks, crustaceans, marine algae, and all other forms of marine life, excluding marine mammals and birds.

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166 As indicated in the minutes of the January 2007 Gulf of Mexico Fishery Management Council Joint Reef Fish/Mackerel/Red Drum Committees meeting, Dr. Keithly raised the issue as to whether Alternative 1 and Alternative 3 are equivalent. He stated "[a]alternative 1 is the status quo, which if I interpret it correctly, working under the EFP, there is no gear specified and so in fact, it becomes the equivalent to Alternative 3, which would, in essence, allow any gear to be used for offshore aquaculture in the Gulf of Mexico (p. 26)." A review of the minutes suggests that the Council members did not disagree with this interpretation.

167 As previously noted the verbiage associated with Alternative 3 is not clear and is open to some interpretation regarding the intent of the Alternative (see previous footnote).

168 Not included in this list are nursery facilities and hatchery facilities. These may be required for offshore aquaculture by may be landbased.

Offshore Aquaculture
The term means all activities, including the operation of offshore aquaculture facilities, involved in the propagation and rearing, or attempted propagation and rearing, of marine species in the United States Exclusive Economic Zone.

Offshore Aquaculture Facility
The term means 1) an installation or structure used, in whole or part, for offshore aquaculture' or 2) an area of the seabed or the subsoil used for offshore aquaculture of living organisms belonging to sedentary species.

As indicated, **Alternative 2** would include all systems currently used for finfish culture with the exception of "ranching[169]." Alternative 2, however, would preclude certain types of systems that may be feasible for the culture of shellfish species and plant species[170]. **Alternative 4** is similar to **Alternative 3** in terms of the types of aquaculture systems that may be employed, but explicitly requires NOAA Fisheries Service to review the proposed system to ensure that it provides adequate environment protections. Therefore, if the applications submitted provide reasonable environmental safeguards, the economic impacts of **Alternative 3** and **Alternative 4** should be approximately the same. In the following discussion the impacts under **Alternative 3** may also be applied to **Alternative 4**.

To address the issue of Net National Benefits associated with **Alternatives 3 or 4** in relation to **Alternative 2** it is useful to examine benefits and costs separately. Benefits, as previously identified, represent increases in producer, consumer, and third party surpluses. With respect to producers (in both the primary and secondary markets), the issue becomes one of whether profits would be higher under **Alternatives 3 or 4** than under **Alternative 2**. With certainty, one can state that expected profits under **Alternatives 3 or 4** would be no less than under **Alternative 2**[171]**.** If there is a demand for the products that can be grown with systems not included in **Alternative 2**, however, and the demand is sufficient such that the output price covers all costs, then profits associated with **Alternatives 3 or 4** will be higher than those associated with **Alternative 2**[172]**.** Furthermore, there is likely to be "jointness" in production activities between

169 Unless Action 4, Alternative 1 is selected, ranching (as defined by the release of juveniles that either return or are "trained" to aggregate for harvest) is likely not a viable option for Gulf offshore aquaculture. Furthermore, the number of species where ranching is applicable appears to be very limited and (a) these species may not survive in the Gulf climate and (b) the NMFS might not allow their use for offshore aquaculture. However, free planted "bottom ranching" of species, such as sponges, corals, or clams that are native to the Gulf would be possible.
170 Plant species, as defined here, include invertebrates such as sponges.
171 Specifically, if expected profitability from the use of these systems is zero or negative, entrepreneurs will not employ them. In this situation, the implications of adopting Alternative 3 are identical to those associated with Alternative 2.
172 While not discussed here, it is also possible that the costs of growing an additional species (which would not be technologically feasible under Alternative 2, may be close to zero. For example, since sponges, corals, and mollusks are filter feeders, they may be able to survive and grow to market size simply by feeding on the waste food particles and fecal material that falls out of the water column (assuming they cultivated on a bottom ranching system). Similarly, Kolian and Sammarco (2005) report that many species including sponges, sea fans, and soft corals are known to live on existing oil-and-gas platforms. Presumably, they would also grow on platforms developed in association with cage culture. Alternative 3 would allow the harvest of these species (depending upon the Alternative selected under Action 4) at little or no additional costs while harvest of these species might be prohibited under Alternative 2 (at a minimum, current commercial fishery regulations would apply). As a final example, Dougall (1998) discusses the harvest of mussels that attach themselves to oil-and-gas platforms in California.

different systems. For instance, given the very high upfront costs and annual variable expenses, it seems reasonable to assume that several different growout systems may be used on any given site. Spreading these fixed and variable costs across systems will provide economies of scale implying higher returns per unit output. Hence, one can conclude that if there is a demand for output that can be grown in a system that would be allowed under **Alternatives 3 or 4** but not **Alternative 2**, then producer surplus to offshore operations would be higher under **Alternatives 3 or 4** than **Alternative 2**. Finally, since producer surplus under Alternative 3 is likely to exceed that of **Alternative 2**, one can conclude that investment would be enhanced if Alternative 3 is adopted.

Depending upon the decline in imports in association with increased aquaculture output, there may or may not be losses in producer surplus in the captured harvesting sector. As previously discussed, if the imported product is a perfect substitute for the domestic product, welfare losses in the domestic harvesting sector (i.e., producer surplus) will, in theory, be zero. If imports constitute an imperfect substitute, there is likely to be some reduction in profits to the domestic harvesting sector. Similarly, if imports and domestic products are perfect substitutes, there will be no gains in consumer surplus. If imperfect substitutes, however, consumers are likely to gain.

As indicated in Section 5.3, imports of many species that compete with wild Gulf production are large and increasing (e.g., shrimp, snappers, groupers). Furthermore, while import data on other species harvested from the Gulf (e.g., cobia) are not disaggregated to the degree needed to ascertain trends in these products, it seems likely that imports of species such as cobia are increasing. Where information is available, furthermore, price of the imported fresh product tends to "mirror" the dockside price of the domestic product; providing *prima facie* evidence that imported products are relatively close substitutes for the domestic product, if not perfect substitutes. Hence, one is led to conclude that offshore aquaculture production may exert relatively little downward pressure on the dockside price of the domestically produced product. If this is the situation, then that Alternative which would generate the greatest amount of producer surplus to the offshore aquaculture sector would also likely provide the greatest net impact to coastal communities in terms of job creation (i.e., **Alternative 3** and **Alternative 4).** Finally, there would likely be little differences in external benefits between **Alternative 2** and **Alternatives 3** or **4**.

As previously discussed, there are three cost components that detract from welfare: private costs, external costs and administrative costs. Private costs are those internal to the operation. While private costs under **Alternatives 3 or 4** are likely to be somewhat higher than under **Alternative 2** (assuming that there does not exist perfect jointness in production where some products are produced with no additional costs), the additional costs would be incurred only if it increased profits. Hence, one can conclude that from the producer's side any increase in costs will be covered by increased revenues.

Historically, these mussels were removed at considerable cost (a few hundred thousand dollars every few years) to maintain the structural integrity of the platform. Subsequently, a California firm capitalized on the opportunity by harvesting the product and selling it to restaurants; a considerable cost savings to the energy companies.

Since **Alternatives 3 or 4** subsumes Alternative 2, it is also clear that external costs to society associated with **Alternatives 3 or 4** will, in general, be at least as large as those under **Alternative 2**[173]**.** However, as previously noted (see Action 3), external costs with offshore aquaculture are thought to be relatively manageable. This may be particularly the case with some types of systems not permitted under **Alternative 2**. For example, concerns associated with navigational hazards may be lessened with some of the systems associated with Alternative 3. One possible external cost of relevance, however, reflects reduction of genetic diversity[174]. Specifically, Alternative 3 would allow for non self-contained systems. While there will undoubtedly be escapement from contained systems (nets and pens), significant escapement will be the exception rather than the rule. Depending upon the source of brood stock, one can ague that changes in genetic diversity of the wild stock may be greater under **Alternatives 3 or 4** than under Alternative 2[175].

Overall, an analysis of this Action leads one to conclude that, under some assumptions, Net National Benefits under **Alternatives 3 or 4** exceed those under **Alternative 2**. Speculative conditions include the following: (a) there is a demand for species that can be grown under **Alternative 3** that can not be grown under **Alternative 2**, (2) such growout systems are profitable, (c) that external costs associated with **Alternative 3** are not significantly higher than those associated with **Alternative 2**, and (d) that administrative costs are not excessive. All of these assumptions, while somewhat speculative, appear reasonable. If there is demand, one can also conclude that investment under **Alternative 3** will exceed that under **Alternative 2**.

7.5.6 Designation of Sites or Areas for Aquaculture

Action 6 considers siting designations. It includes two alternatives and the status quo. These are reviewed in this section, and to the extent possible, a qualitative discussion of the economic impacts associated with selecting each alternative is provided

Alternative 1: No action (status quo). Do not designate areas in the Gulf of Mexico EEZ where aquaculture would be allowed. The Army Corp of Engineers (ACOE) would permit sites for aquaculture. NOAA Fisheries Service and the Council would continue to review and comment on ACOE siting permits.[176]

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173 There is at least one possible exception to this general rule. Theoretically, growing species that would be technically unfeasible in the absence of Alternative 3 with those that would be technically and economically feasible under Alternative 2 may reduce external costs. For example, if filter feeders grown in a bottom ranching system assist in removing wastes (food pellets, fecal matter, etc.) associated with those species grown in a system allowed under Alternative 2, external costs may fall.

174 It is assumed here that non-indigenous species (See Action 4, Alternative 1) would not be permitted in a non self-contained system.

175 This concern, however, is likely to be largely mitigated by the fact that Alternatives 2 through 4 under Action 4 would preclude the use of genetically modified native species in offshore aquaculture operations.

176 Section 10 of the Rivers and Harbor Act of 1899 (33 U.S.C.) states that " the creation of any obstruction not affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States is hereby prohibited; and it shall not be lawful to build or commence the building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structures in any port, roadstead, haven, harbor, canal, navigable river, or other water of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of War;…, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning the same.

This alternative would continue to allow any action entity to place an offshore aquaculture structure anywhere currently permitted. Maintaining the status quo (**Alternative 1**) will result in no changes in Net National Benefits. The Net National Benefits of the status quo, however, may be smaller or larger than those associated with the two alternatives. Net National Benefits associated with **Alternatives 2** and **3** in relation to the status quo are examined below.

Alternative 2: Establish marine aquaculture areas. These pre-permitted areas could be used for marine aquaculture and other uses of the area:

a) may be restricted or
b) would not be restricted.
Aquaculture operations would not be limited to these marine aquaculture areas, but pre-permitting areas would allow faster review of applications.

This alternative would begin to create designated areas (zones) for offshore aquaculture. Other activities in these areas may or may not be restricted. Finally, while aquaculture operations would not be limited to these areas, review of permit applications for a site within these areas would be reviewed more rapidly than permit applications outside the designated areas.

There are at least two potential benefits to establishing designated aquaculture areas. First, there is the potential to reduce user conflicts if the designated sites are established in areas outside of areas heavily used in other activities (e.g., commercial fishing or recreational fishing). Second, proper siting of these designated areas can help to ensure ecosystem integrity (siting in an area that has sufficiently strong current to dispose of wastes).

Given that aquaculture operations would not be limited to these marine aquaculture areas, there are few if any direct additional costs (relative to the status quo) to business ventures considering offshore operations (other than a delay in the application review). Likewise, however, additional benefits (relative to the status quo) may be few. Specifically, any benefits that might be realized under a true zoning process would tend to be dissipated by entrepreneurs applying for permits and eventually developing facilities outside of the designated areas.

Overall, without additional information it is impossible to state that any benefits would be forthcoming from the establishment of these (voluntary) designated areas. To some extent, it would depend on whether applications would be made for space within the designated areas. If the areas that are eventually designated are outside the areas desired by the potential aquaculture

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According to the Corps of Engineers website, the following criteria are considered in evaluating all applications: (a) the relevant extent of public and private needs, (b) where unresolved conflicts of resource use exist, the practicability of using reasonable alternative locations and methods to accomplish project purposes, and (c)the extent and permanence of the beneficial and/or detrimental effects the proposed project may have on public and private uses to which the area is suited. If found to be contrary to the public interest, the permit will not be issued (http://www.usace.army.mil/cw/cecwo/reg/oceover.htm.)

businesses, then one is led to conclude that their applications will be for sites outside the designated areas. In such a situation, benefits would be zero.

While benefits would be zero, this does not necessarily imply that costs will also be zero. Specifically, if other uses of the area are restricted, costs to other users of the ocean space in the designated area would increase (assuming that there are other users). As one example, if the if the designated areas displace traditional fishing areas of either commercial or recreational fishermen, there will be some dislocation costs.177 In this situation, Net National Benefits would decline. Costs would be zero, however, if there were no other uses for the designated areas[178].

In summary, one cannot conclude that that the Net National Benefits associated with **Alternative 2** are greater than those associated with the status quo (**Alternative 1**). If restrictions are placed on other uses in these designated areas, one can conclude that the National Net Benefits associated with **Alternative 2** may be less than those associated with the status quo.

Alternative 3: Do not establish marine aquaculture areas, but establish criteria for siting marine aquaculture facilities (see table 6.7-1 for a list of criteria).

Section 10 of the RHA prohibits "the creation of any obstruction" to navigation within state and federal waters. Therefore, as noted by Welles (2005):

> "… an applicant must obtain a Section 10 permit from the ACOE before constructing an offshore aquaculture facility. Prior to issuing a Section10 permit, the ACOE must consider "a broad range of potential environmental and other impacts[179]." The potential environmental impacts include: water quality, pollution, economic factors, safety, accurate charting of any structures, aesthetics, navigational integrity, and the effects of the structure on recreation, fish, and other wildlife[180].

Based on this, one can conclude that the ACOE uses a set of criteria when reviewing applicants. These criteria, as noted, include (a) the relevant extent of public and private needs, (b) where unresolved conflicts of resource use exit, the practicability of using reasonable alternative locations and methods to accomplish project purposes, and (c) the extent and performance of the beneficial and/or detrimental effects the proposed project may have on public and private used to which the area is suited

177 An initial review of this document suggested that non-aquaculture vessels transporting through the zones or pipelines or cables being placed there might also be prohibited. Authority granted in the Magnuson-Stevens Act likely does not extend to these types of activities.
178 One caveat to this statement should be made. Specifically, there are likely to be some relatively minor administrative costs associated with these designated areas, even if (a) potential aquaculture establishments eventually develop a facility outside the area and (b) there are no other current users of the designated areas.
179 *Offshore Framework*, p. 73
180 *Offshore Framework*, p. 73

While this might be the case, the set of standards used by the ACOE are not specified in detail which may lead to uncertainty on the part of potential investors in offshore aquaculture[181]. **Alternative 3** would provide a clearer set of standards and the standards set by NOAA Fisheries Service (and the Council) may be either more or less restrictive than those set by the ACOE.

Based on the criteria in Table 6.7.1 the NOAA Fisheries Service siting criteria concerning the MSFCMA issues such as protection of essential fish habitat may be more restrictive than the ACOE criteria. While possibly more restrictive, the criteria, as presented, will minimize many of the external costs previously considered. While there are undoubtedly benefits in reducing external costs, where possible (i.e., the benefits equal the reduction in external costs), it is uncertain whether these benefits outweigh costs that might be associated with siting in a "less than preferred" setting.

Adopting this alternative would not negate the need for the applicant to obtain a Section 10 permit from the ACOE and if some aspects of the ACOE criteria are more stringent than those developed by NOAA Fisheries Service, the application for a Section 10 permit will likely be denied[182]. In this situation, the Net National Benefits associated with **Alternative 3** "collapses" to that associated with the status quo (**Alternative 1**). If, however, a written memorandum can be developed whereby the ACOE will agree to allow siting of marine aquaculture facilities based on the criteria developed by the Council (and NOAA Fisheries Service), then there would likely to be some benefits associated with the transparency. In particular, time may be saved by both potential investors and management agencies since applications will not be submitted (or could easily be rejected) that do not meet the specified criteria. Having this criteria explicitly stated, furthermore, might reduce costly litigation in instances where applications are denied.

Preferred Alternative 4: Do not establish marine aquaculture areas but establish general siting criteria to be applied on a case-by-case basis to ensure reliable offshore growing system technology is used to provide environmental safeguards. Siting criteria would include, but not be limited to the items in Table 6.7-1, and the requirements of ACOE, MMS, EPA, NOAA Fisheries Service, and other regulatory agencies with authority in the EEZ as applied to aquaculture.

The economic impacts of **Preferred Alternative 4** are expected to be similar to those that would result under **Alternative 3**. Neither alternative would establish marine aquaculture areas, but both would establish general siting criteria that would be used in part to determine whether a site was suitable. **Preferred Alternative 4** does go farther, in terms of defining that applications would be applied on a case-by-case basis to provide environmental safeguards and including other agencies siting requirements.

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181 In discussing the role of the U.S. Army Corps of Engineers in section 10 permitting, the Sustainable Marine Aquaculture Task Force report (2007) states, "[a]lthough the COE typically considers environmental effects in its review and must also comply with the National Environmental Policy Act by considering environmental impacts of granting the permit, it has broad discretion and little specific direction by Congress regarding how to address environmental impacts (p. 26)."

182 There is likely to be an exception to this general finding. If the Council selects Action7, Alternative 3, there may be instances where the role of the COE is diminished (since no semi-permanent or permanent structures may be required.

The case-by-case review of the siting application could increase the cost and time of the permitting process. Under **Alternative 3**, a permit could be issued if the firm selected an area that met all the general siting criteria. **Preferred Alternative 4** would require that the proposed site and growing technology are compatible to ensure that negative environmental impacts would be minimized. The amount of additional time required to complete that review will depend on the staff available to conduct the review, the number of siting permits that are under review, and level of controversy surrounding whether that site is appropriate. If the site and growing technology are not controversial and NOAA Fisheries Service staff is available to review the proposal, the cost and time to acquire the permit should be similar to **Alternative 3**. It is conceivable, however that a backlog of permit applications or a marginal site proposal could delay approval by weeks, or potentially months. The costs of the delay for the applicant would be the increased time to start production and additional costs that could be incurred debating the permit requirements. NOAA Fisheries Service would incur higher costs if more staff time were required to resolve the application approval or denial. However, the increased costs would not be expected to outweigh the benefits that the Nation would derive from increased environmental safeguards.

Preferred Alternative 4 also explicitly states that the siting criteria would include siting requirements from other agencies that are tasked with overseeing specific activities. The intent of this component is to recognize that other agencies are also involved in the siting process and not to duplicate the requirements of other agencies.

Appendix A from Bridger (2004) provides a summary of work presented by Fletcher and Weston (2004) on the legal and regulatory environment of the offshore aquaculture permitting process. That information is used here to provide a summary of permitting roles of the ACOE, EPA, and MMS.

ACOE permit requirements are a result of the Section 10 of the Lakes and Harbors Act of 1899, as extended by the Outer Continental Shelf Lands Act (OCSLA). A Section 10 permit is required when an obstruction is permanently or temporarily attached to the seabed. The OCSLA extended the ACOE authority into the EEZ by allowing the agency to regulate "installations and other devices permanently attached to the seabed, which may be erected thereon for the purpose of exploring for, developing or producing resources from the outer continental shelf" (Bridger, 2004). The ACOE considers several potential impacts before issuing a Section 10 permit. Some of the areas considered are the effects and impacts on water quality, recreation, fish, other wildlife, pollution, safety, aesthetics, navigational integrity, and economic impacts.

The EPA, under Section 318 of the Clean Water Act requires a point source pollution discharge permit for aquaculture projects in the open ocean. Factors considered when reviewing the permit application include the need for proposed dumping and effects on human health and welfare, fisheries resources, plankton, fish, shellfish, wildlife, shorelines, beaches, and the marine ecosystem.

The MMS has jurisdiction, under the Outer Continental Shelf Lands Act, to oversee lease sites that are attached or near an oil or gas platform. MMS requires a permit for platform removal or transfer of ownership.

Because each of the above agencies requires specific information before a permit would be issued, the additional cost of NOAA Fisheries Service requiring similar information would likely be limited to the cost of sending the information to NOAA Fisheries Service. The data would not need to be recreated, so the costs associated with providing the additional data would be the time and copy/printing charges of sending the additional information. If the additional information required 20 pages at $0.10 per page, it would cost $2.00 plus shipping costs and the time to print and mail the information. A reasonable estimate to assemble, print, and mail the information would be about 10-15 minutes for 20 pages.

The establishment of reserved aquaculture sites would limit other users access to those areas. Commercial and recreational harvesters would be prohibited from entering aquaculture sites to fish. The impacts on commercial and recreational fishing are also expected to be negligible. The permitting process selected under Alternative 3 or Preferred Alternative 4 would define sitting criteria to protect the interests of commercial harvesters and charter/headboat operators. As a result of those criteria, aquaculture sites would not be allowed in areas that include:

- Federally recognized marine reserve, marine protected area, habitat area of particular concern, government or public artificial reefs;
- Ecologically important habitat (e.g., coral reefs, hard bottom);
- Traditionally important fishing areas;
- Seagrass beds;
- Important nursery habitat; or
- known spawning areas.

By eliminating these areas from being sites for aquaculture, the interactions and conflicts between user groups should be minimized.

An alternative argument has been made to the negative impacts aquaculture sites would have on recreational and commercial fishing, is that the aquaculture structures and increased availability of fish feed could enhance the survival and growth of the wild stocks around the sites. As a result, fishing (e.g., average catch per trip) may be enhanced around the sites may be enhanced relative to before the site was developed..

All vessels not associated with the aquaculture firm or enforcement staff would be prohibited from entering or transiting through the site. Because the total area of the sites are expected to be relatively small, based on the 3 leases in Hawai'i totaling 193 acres, the impacts on water transportation and vessels transiting through and area are expected to be minimal.

7.5.7 Establish Buffer Zones for Marine Aquaculture Facilities

The Council is considering restricting access around marine aquaculture facilities. There is one alternative (create buffer zones) and the status quo. The alternative under consideration is presented in this section, and to the extent possible, a qualitative discussion of the economic impacts associated with selecting this alternative relative to the status quo is provided.

Preferred Alternative 1: No action (status quo). Do not restrict access around marine aquaculture facilities.

Alternative 2: Create buffer zones for marine aquaculture facilities that within the boundaries of which, fishing and fishing vessels would be prohibited.

The Council does have authority to create zones that exclude certain persons or activities. Examples are zones where fishing with certain gear is prohibited and no-take zones where fishing and possession of fish is prohibited. Creation of buffer zones for aquaculture facilities (**Alternative 2**) may provide some limited benefits to investors; particularly in terms of liability issues and protection of investment. The buffer zones may also facilitate and strengthen enforcement activities (i.e., being inside the buffer zone may provide the presumption of guilt). The costs associated with creating buffer zones, such as (a) additional dislocation of commercial and recreational fishing activities (b) non-aquaculture vessels transporting through the zone, and (c) pipelines and cables being placed there are expected to be very minor, but are likely to increase in relation to the size of the established buffer zone[183].

While lack of any detailed information on this Action precludes a detailed assessment of economic impacts, one can conclude with some degree of certainty that the Net National Benefits associated with **Alternative 2** will be greater than that under the status quo (**Alternative 1**) if created buffer zones are reasonable in size.184 Unreasonably sized buffer zones, however, may result in a loss in Net National Benefits associated with **Alternative 2** relative to the status quo.

The need for buffer zones will depend on the structure of Action 6. If the permit sites provide sufficient protections for the aquaculture firms, setting aside additional space for a buffer zone would not be needed or create any additional benefits for the aquaculture firm. For example, liability and protection of investment would be mitigated if the permit site included an area around the actual structures that would prevent unauthorized individuals from tampering with the facility.

7.5.8 Recordkeeping and Reporting

Recordkeeping and reporting requirements are being considered to enable NOAA Fisheries Service to monitor the activities and impacts of the offshore aquaculture industry. Each of the alternatives and options under consideration will be discussed briefly in this section. Adding these requirements will tend to increase costs for the industry and the agency collecting the data, but the benefits of collecting that information are assumed to outweigh those costs. The actual costs will likely vary by business. The costs businesses will incur are not expected to be overly burdensome.

Two alternatives are being considered that would define the recordkeeping and reporting requirements that must be met by persons operating an aquaculture business in the Gulf EEZ. The first alternative would maintain the status quo where the RA determines the reporting

183 One (potential) additional cost discussed in the literature reflects aggregation of fish around the structures. If aggregation is significant, catch per unit effort outside the buffer zone may decrease.
184 In reaching this conclusion, it is implicitly assumed that any site permit would approximate the size of the offshore aquaculture facility and that a zone would expand upon this boundary.

requirements for an EFP. **Alternative 2** provides a suite of recordkeeping and reporting requires from which the Council may select any or all of the options. Representatives of the aquaculture firms applying for, or being issued a permit, must also submit additional information as a condition of their permit. Those data submission requirements will be addressed in the next section of this document.

The National Aquaculture Act of 1980 as amended directs the Secretary of Commerce to collect and analyze scientific, technical, legal, and economic information relating to aquaculture, including acreages, water use, production, marketing, culture techniques, and other relevant matters. Guidance from the National Aquaculture Act of 1980 indicates that relevant physical, biological, and economic information should be collected from aquaculture facilities. The types of information described in the Act are similar to the information requested under **Alternative 2**.

Proprietary information submitted to the Secretary is considered confidential and may only be disclosed if required under court order. The Secretary may release or make public any information in any aggregate or summary form that does not directly or indirectly disclose the identity, business transactions, or trade secrets of any person who submits the required information under the status quo or **Alternative 2**.

Alternative 1: No action (status quo). The Regional Administrator has authority to specify recordkeeping and reporting requirements in an EFP (50 CFR 600.745).

Costs incurred by Federal agencies and the industry as a result of selecting the status quo are expected to be close to zero. As reported in the Management Section of the EA, four applications for an EFP to conduct offshore aquaculture in the Gulf EEZ have been submitted since 1997. None of the applicants are currently operating aquaculture businesses in the Gulf EEZ, because their application was denied, funding was not available, or the permit had not been acted on by the RA. Growth in the offshore aquaculture sector is not anticipated to occur if the status quo is continued and a very limited number of EFP are expected to be submitted in the future, if any, based on historic trends. If firms do not submit applications, no costs are incurred.

Historically, firms that submitted the applications and the agency that reviewed them incurred costs. The cost of submitting each of the permit applications is not known. The costs for NOAA Fisheries Service to review the documents would depend on the reports submitted. Applications that are incomplete or do not meet the EFP guidelines could be quickly rejected. Applications requiring more thorough review would take more time and be more expensive. NOAA Fisheries Service would need to provide information on the average cost incurred to review an EFP application.

The costs to submit the EFP were likely a small part of the overall cost a business would have incurred to develop their business plan, meet all the regulatory requirements, and starting production. Recall that cost estimates of an initial fixed investment of $2.89 million and annual operating capital of $1.28 million (Posadas and Bridger 2003) were presented for what would be considered a small operation. The fixed investment would cover the costs of vessels, pens, office equipment, etc. If 1 percent was allocated to permit applications it would be about $30,000.

Another cost of maintaining the status quo could be the forgone net national benefits that might accrue to the Nation if the regulatory structure were changed to foster development of offshore aquaculture. Because of the uncertainties associated with the growth of the industry, the profitability of firms entering the business, and the impacts aquaculture firms would have on suppliers of production inputs and processors and marketers of the product, it is not possible to estimate, with any certainty, the change in producer surplus that would result from changing the regulatory structure. Consumer surplus cannot be estimated because information is not available on production of seafood from the firms that may apply for permits and the value U.S. consumers would assign to that product.

Preferred Alternative 2: Establish the following reporting and recordkeeping requirements for aquaculture permits:

- **a) Provide NOAA Fisheries Service with copies of state, ACOE and EPA permits and monitoring reports.**
- **b) Report all fish to be landed or harvested from the facility to NOAA Fisheries Service**
- **c) Report all incidents of any disease or parasites impacting greater than 10 percent of the cultured organisms immediately after diagnosis to NOAA Fisheries Service. Information reported would include percent of cultured organisms infected; a plan of action for managing the disease outbreak with treatment and consultations with marine fish disease specialists.**
- **d) Notify NOAA Fisheries Service of any of the following events:**
  i. Major escapement and reasons for escapement. Major escapement is defined as cumulative escapement of 10 percent or more of stocked fish;
  ii. entanglements or interactions with marine mammals, endangered species, and migratory birds.
- **e) Notify NOAA Fisheries Service of any changes in sources used for providing fingerlings**
- **f) Keep copies of feed labels on file for three years from date of use.**
- **g) Keep all harvest and sale records for three years. Sale records should include the names of companies and individuals to whom fish are sold.**
- **h) Inform NOAA Fisheries Service when the type of aquaculture system used for culture is changed.**
- **i) All new species to be cultured should be approved by NOAA Fisheries Service prior to introduction to the offshore growout facility.**
- **j) Require a standardized annual report to address activities in these areas.**
- **k) Any other appropriate recordkeeping and reporting requirements, as specified by the NOAA Fisheries Service Regional Administrator, necessary for issuance, review, and administration of an aquaculture permit**

The Council could implement any or all of the options above. **Alternatives 2(f)** and **2(g)** do not require the firm to report information to NOAA Fisheries Service. Those options require the firm to retain information on the feed that was used by the firm and the harvest and sales records of the firm. The conditions under which NOAA Fisheries Service or NOAA GC could access those records are not defined in this action. The cost of maintaining the feed labels would include the labor cost associated with collecting and filing the labels and the cost of file cabinets or other devices used to store the labels for the required three years. Other costs could be

incurred if the firm was required to submit the labels or summaries of the labels to NOAA Fisheries Service. Sales receipts should be generated when product is sold. Keeping copies of that information would be considered a reasonable practice for most businesses. Similar information would likely be required for tax and other purposes, so implementing the requirement should not create additional costs.

The firms would be required to report specific information to NOAA Fisheries Service under each of the other options. **Alternative 2(a)** requires the firm to supply copies of permits and monitoring reports that are generated for other agencies. Those reports would need to be submitted when they are initially generated or modified. The cost of submitting those reports would be the cost of obtaining a copy of the original report (or making copies) and the labor costs associated with obtaining the reports and mailing them to the agency. Those costs are expected to be minimal since no additional time is needed to create the actual information contained in the report.

Alternative 2(b) would require the firm to submit a report for all fish harvested or landed from their facility. The information would likely be submitted on a form (paper or electronic) that would be generated by NOAA Fisheries Service that is similar to commercial trip tickets. Those forms typically request information on the business, where the fish were harvested, the species harvested, and the method of harvest. Depending on when the report is generated, it could also contain information on the fish buyer or processor and economic information on revenues, costs, or employment. The cost of submitting this information would be similar to that incurred by commercial harvesters or processors when they submit trip ticket or logbook reports. The frequency of the submissions would depend on the number of times a firm harvests their stock, since a report must be submitted every time fish are harvested. The number of reports annually would vary by business and would depend on the species, the size of their facility, and the markets they have developed for their products.

The remainder of the options, with the exception of option 2(k), would trigger the submission of information to NOAA Fisheries Service under specified conditions and a report would need to be submitted every time the condition is met. **Alternatives 2(c)** and **2(d)** would mandate that the firms provide NOAA Fisheries Service with information when a disease outbreak, escapement, or entanglement occurs. The cost of submitting the report is not expected to be time consuming or costly, but the information being made available to NOAA Fisheries Service could be very valuable. Many organizations and people are concerned that aquaculture firms are using a public resource to operate their businesses, and that those businesses could impact the wild stocks of fish in the Gulf. It is very important that the NOAA Fisheries Service and the general public be informed of activities that occur at those facilities that could impact the overall health of the ecosystem.

Alternatives 2(e), **2(h)**, and **2(i)** would require the aquaculture firm to report information relative to changes in business practices. Each of the options relates to information that would be required on the firms permit application(s). The requested information would be used to update permits. If the changes to the firm are minor, NOAA Fisheries Service could use the information to amend a current permit. If the changes are considered major departures from the original permit, then the firm would likely be required to submit a new permit application so the

entire operation could be reviewed. Applying for a new permit(s) would be more costly than providing a simple notice of change in the operation of the business.

Alternative 2(j) would require the firm to submit an annual standardized report that would be developed by NOAA Fisheries Service to summarize the information requested in **Alternatives 2(a)-2(i)**. The information requested would be an annual report on the activities of the firm that were already required. The additional report will require time to complete, but since NOAA Fisheries Service will develop the required questions and provide them on standardized form the firm should be able to collect and organize the required data throughout the year. If the firm has the needed information organized, the time requirements should be similar to the 1 hour required to submit an EFP. NOAA Fisheries Service will also incur costs to develop the data collection instruments, but the form should be relatively easy to develop given the types of information being requested. Data collected from those reports could be used by NOAA Fisheries Service to produce summarized data on the activities of the industry. Those reports could be made available to the general public in a non-confidential format to provide information on how well the industry is performing in terms of production and environmental impacts.

No special skills would be needed to provide these reports. The information contained in the reports would require the firm to summarize findings from marine fish disease specialists they hire to maintain the health of their stocks. Those expenses would accrue as part of the normal health maintenance program employed by the firm. The ability to use a computer would be required to submit electronic reports. Hard-copy reports would not require any special skills.

Alternative 2 (k) provides no elaboration regarding what other reporting requirements, as determined by the Regional Administrator, might be appropriate. Hence, one is not able to assess at this juncture whether firms might incur any significant costs associated with this option or whether there would be any significant benefits. Clearly, if the Regional Administrator does not imose any additional recordkeeping and reporting requirements, costs will be zero as will be the benefits. Costs would increase in relation to the amount of additional recordkeeping and reporting specified by the Regional Administrator and the amount of special skills needed to perform the requirement**.**

7.6 Determination of Significant Regulatory Action

Pursuant to E.O. 12866, a regulatory action is considered a "significant regulatory action" if it is likely to result in a rule that may: a) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, State, local, or tribal governments and communities. communities; b) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; c) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or d) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

Currently, the Council's preferred alternative is to establish a regulatory structure that would allow NOAA Fisheries Service to issue permits that would allow persons to operate an

aquaculture business in the Gulf of Mexico EEZ. The Council's preferred aquaculture permit features are discussed in Section 7.5 and are included here by reference.

It is not possible to determine with any measure of certainty whether the action will have a $100 million or more annual effect on the economy. However, the action does create the potential for an industry to develop that would meet that threshold. This action also could generate controversy in terms of potential environmental impacts. Therefore, the proposed amendment is considered a significant regulatory action.

8.0 Initial Regulatory Flexibility Analysis

8.1 Introduction

The purpose of the Regulatory Flexibility Act (RFA) is to establish a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration. The RFA does not contain any decision criteria; instead, the purpose of the RFA is to inform the agency, as well as the public, of the expected economic impacts of various alternatives contained in the FMP or amendment (including framework management measures and other regulatory actions) and to ensure that the agency considers alternatives that minimize the expected impacts while meeting the goals and objectives of the FMP and applicable statutes.

With certain exceptions, the RFA requires agencies to conduct a regulatory flexibility analysis for each proposed rule. The regulatory flexibility analysis is designed to assess the impacts various regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those impacts. In addition to analyses conducted for the RIR, the regulatory flexibility analysis provides: (1) a statement of the reasons why action by the agency is being considered; (2) a succinct statement of the objectives of, and legal basis for the proposed rule; (3) a description and, where feasible, an estimate of the number of small entities to which the proposed rule will apply; (4) a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirements of the report or record; (5) an identification, to the extent practical, of all relevant Federal rules which may duplicate, overlap, or conflict with the proposed rule; and (6) a description of any significant alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities.

In addition to the information provided in this section, additional information on the expected economic impacts of the proposed action are included in Sections 6.0 and 7.0 and is included herein by reference.

8.2 Description of Reasons Why Action by the Agency is Being Considered

A statement of why this action is being considered is presented in Sections 1.0, 2.1, and 3.0 and is incorporated herein by reference. In summary, the purpose for this action is to develop a NOAA Fisheries Service permitting structure that would allow persons to develop offshore aquaculture businesses that would grow and harvest native species in the Gulf of Mexico EEZ. NOAA General Counsel's Office has concluded that possession of cultured species managed by a Regional Fishery Management Council in the EEZ would constitute fishing as described in the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Therefore, any aquaculture activity conducted in the EEZ is subject to all applicable FMP regulatory requirements, such as size limits, bag limits, trip limits, time and area closures, and permit requirements.

8.3 Statement of the Objectives of, and Legal Basis for, the Proposed Rule

It is the objective of the Department of Commerce and NOAA to create economic opportunities in aquaculture that are environmentally sound, sustainable, and maximize the benefits of U.S. coastal resources benefiting local, regional, and national economies. This action is designed to develop the permitting guidelines that would allow an aquaculture industry to develop that meets those objectives. The Magnuson-Stevens Fishery Conservation and Management Act provides the statutory basis for the proposed rule.

8.4 Description and Estimate of the Number of Small Entities to which the Proposed Rule will apply

The proposed action would directly regulate aquaculture entities that participate in the Gulf EEZ. Commercial fishers and charter/headboat operators would be directly regulated by prohibiting them from fishing or transiting through areas that are designated for aquaculture. Water transportation could also be directly regulated if closing areas in the Gulf for aquaculture use alters their shipping routes.

The Small Business Administration (SBA) has established size criteria for all major industry sectors in the U.S. including finfish farming and fish hatcheries, shellfish farming, fish harvesters, fish processors, fish dealers, charter/headboat operations, and water transportation. The SBA size criteria applies to a business if it is independently owned and operated, is not dominant in its field of operation (including its affiliates), and is under the SBA threshold for income or employees for all its affiliated operations worldwide. A business involved in finfish farming/fish hatcheries (NAICS code 112511) is classified as a small business if it has average annual receipts less than $750,000. Shellfish farming (NAICS code 112512) considered a small business if it has average annual receipts less than $750,000. A business involved in fish harvesting (NAICS code 114111, finfish fishing) is classified as a small business if it has average annual receipts less than $750,000. For seafood processors and dealers, the SBA uses an employee threshold rather than a receipts threshold, of 500 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide for a seafood processor and 100 or fewer persons for a seafood dealer. A charter or headboat firm is considered a small entity if it has average annual receipts less than $6.5 million. The small business threshold for water transportation (Subsector 483 - Water Transportation) is average annual receipts less than $500 million. The SBA also defines a subset of water transportation businesses that provide "Offshore Marine Services". The applicable size standard is average annual receipts of less than

$25.5 million for firms furnishing specific transportation services to concerns engaged in offshore oil and/or natural gas exploration, drilling production, or marine research; such services encompass passenger and freight transportation, anchor handling, and related logistical services to and from the work site or at sea.

This amendment would provide an opportunity for persons to develop aquaculture businesses that would operated in the Gulf EEZ. Given the uncertainty surrounding the persons that will apply for permits, it is not possible to describe the aquaculture businesses directly regulated by this action in terms of their numbers, characteristics, or size. However, based on the limited information that is available, it is anticipated that any finfish aquaculture firms that are developed would have average annual gross receipts of more than $750,000. This assumption is based on work by Posadas and Bridger (2004) that suggested a 12-cage operation is economically feasible in the Gulf for red drum, red snapper and cobia at stocking densities of $30kg/m^3$. Posadas and Bridger also estimated that the annual gross receipts, for a 6-cage system stocked at $30kg/m^3$, would be about $2.3 million. Gross receipts at that level are about 3-times larger than the threshold for a small business as defined by the SBA. Waldemon Nelson International Inc (1996) estimated that the start-up and capital costs to convert an offshore oil and gas platform to aquaculture production would be $6.8 to $7.5 million. Start-up costs of that level, in addition to the annual operating described by Posadas and Bridger, would require a firm to generate annual gross receipts of more than $750,000 to cover costs. Section 2.2 of this amendment describes offshore aquaculture operations that have been developed. One of the firms discussed in that section is Kona Blue Water Farms (Kona). Kona was formed in 2001. The company reported a total investment of $33 million dollars to date (HDLNR and DA 2006). Investments of that magnitude indicate that the average annual gross receipts for a viable finfish aquaculture firm will exceed $750,000.

Given the size of investment in the studies of offshore aquaculture to date and the expectation that as marine aquaculture expands it is likely to become more consolidated and automated, none of the finfish aquaculture firms are expected to be classified as small entities. Automation and consolidation increases are expected for offshore aquaculture because the energy and labor costs associated with feeding and facility maintenance increase with distance from shore (Marine Aquaculture Task Force, 2007).

Only shellfish covered under a Gulf FMP are included in this amendment. Those species are stone crab and spiny lobster (shrimp was excluded from the amendment). It is not known whether either of these species will be grown using offshore aquaculture facilities. Because no information is available in the current literature describing these types of operations it is neither possible to determine if firms will focus on the production of these species nor the cost structure of firms that might develop. If these species are produced in conjunction with finfish species, the firms raising them are not expected to be small entities.

Since the live rock fishery is excluded from this amendment, the startup, capital, and annual costs of developing an offshore production facilities is assumed to be large enough that none of the businesses operating under the proposed permits will be classified as small entities.

Information provided in the RFA for Generic Amendment 3 for EFH is the basis for the commercial fishery participants (GMFMC 2005). Information from that amendment is incorporated here and modified to update recent regulatory changes and the number of permits

that are currently issued. These businesses are directly regulated because they would be prohibited from fishing and transiting through aquaculture sites.

About 5,322 commercial Gulf shrimp boats were active in 2005. That number has been reduced through the Federal Gulf shrimp permit program established by Amendment 13. Under that program a total of 1,848 permits have been issued as of October 2007.

Total food shrimp landings and revenues were 134.56 million pounds (tails) and $347.34 million, respectively (GMFMC 2007). More detailed information in the Gulf shrimp fishery can be found in Gulf Shrimp Amendment 27–14. That information is included here by reference. Gulf Shrimp Amendment 14 reported the maximum gross revenue for shrimp vessels that are expected to qualify for a permit was approximately $1.9 million in 2005. The shrimp fishery has experienced economic hardship from hurricanes and competition from imports, and so present revenues may be less than reported. Based on the above information it is assumed that all shrimp harvesters should be classified as small businesses based on the SBA $4 million gross revenue criteria.

As of October 2007, there are 945 active commercial reef fish permits for the Gulf of Mexico. A survey of commercial reef fish vessels (Waters 1996) found the following income configuration:

	Gross Income	Net Income
High-volume vessels, vertical lines:		
Northern Gulf:	$110,070	$28,466
Eastern Gulf:	$ 67,979	$23,822
Low-volume vessels, vertical lines:		
Northern Gulf:	$ 24,095	$ 6,801
Eastern Gulf:	$ 24,588	$ 4,479
High-volume vessels, bottom longlines:		
Both areas:	$116,989	$25,452
Low-volume vessels, bottom longlines:		
Both areas:	$ 87,635	$14,978
High-volume vessels, fish traps:	$ 93,426	$19,409
Low-volume vessels, fish traps:	$ 86,039	$21,025

The recent implementation of the IFQ fishery for red snapper (Reef Fish Amendment 26) is expected to consolidate harvests of red snapper among harvesters. Consolidation will be limited by the 8 percent ownership cap included in that amendment, so it is expected that reef fish vessels will all continue to be classified as small businesses under the $4 million gross receipts threshold.

Fish dealers may also be affected by the measures in this amendment. A federal permit is required for a fish dealer to purchase reef fish from commercial vessels. According to the NOAA Fisheries permit data there are 142 federally permitted dealers in the Gulf region. The majority of them (68) are located in Florida, which includes the Florida Keys, followed by Louisiana with 31 and Texas with 24.

Average employment information per reef fish dealer is not known. Although dealers and processors are not synonymous entities, Keithly and Martin (1997) reported total employment for reef fish processors in the Southeast at approximately 700 individuals, both part and full time. It is assumed that all processors must be dealers, yet a dealer need not be a processor. Further, processing is a much more labor-intensive exercise than dealing. Therefore, given the employment estimate for the processing sector, it is assumed that the average dealer employment would not surpass the SBA employment benchmark. Based on the gross revenue and employment profiles presented above, all commercial and for-hire fishing vessels and reef fish dealers potentially affected by the proposed regulations are classified as small entities.

As of October 2007, 132 non-Florida spiny lobster permits were issued and 299 tailing permits. None of the spiny lobster fishing operations in the Gulf of Mexico approaches the $4 million threshold. Muller and Bert (1997) estimated the number of participants in the stone crab fishery during 1995-1996 to be about 1,689 (based on the number of Saltwater Product Licenses (SPL) with stone crab endorsements that reported landings). The number of SPLs, however, does not match one to one with the number of vessels/boats; that is, several SPLs may be associated with one vessel/boat or several vessels/boats may be associated with one SPL.

The average number of fishing crafts in the stone crab fishery for the period 1985-1994 was estimated at 720, with an average of 234 being vessels (i.e. fishing crafts greater than 5 net tons) and 486 were boats (Vondruska 1998). The highest ex-vessel revenues from stone crab landings were registered in 1997 at $31.924 million. Using these two numbers, the averaged ex-vessel revenue would amount to $44,339. This number is obviously pulled down by the number of boats vs. vessels in the fishery. If it is assumed that all landings were made only by the 234 participating vessels (average for the 1985-1994 period), then the average gross revenue would amount to about $136,427. These businesses are all considered small businesses.

Reef Fish Amendment 25 and Coastal Migratory Pelagics (CMP) Amendment 17 extended the charter/headboat moratorium permit regulations in the Gulf (GMFMC 2005b). As of October 2007, the number of permits held as a result of that amendment are 1,348 for coastal pelagics and 1,356 for reef fish.

Swordfish and shark harvesters are also permitted in the Gulf. A total of 180, 80, and 82 permits were held, as of October 2007, for the directed, incidental, and handgear fisheries for swordfish. In the shark fishery, 132 directed fishing permits and 283 incidental permits are held.

For-hire vessel costs and revenues are not routinely collected in the Gulf region. However, the information that was presented in Reef Fish Amendment 25 and CMP Amendment 17 appears to indicate that all of the Gulf charter and headboat operations would be classified as small entities. Charter and headboat that operate in the South Atlantic and other parts of the U.S. are not directly regulated by this action. Because they are not directly regulated they are outside the scope of this analysis.

It is not possible to determine the number of small entities that operate in the water transportation industry in the Gulf of Mexico. Data that describes the number of firms that have average annual gross revenues less than $500 million ($25.5 million for firms furnishing specific transportation

services to concerns engaged in offshore oil and/or natural gas exploration, drilling production, or marine research; such services encompass passenger and freight transportation, anchor handling, and related logistical services to and from the work site or at sea) are not available. However, because of the amount of area that is expected to be set-aside for aquaculture is expected to be relatively small, the areas closed to ship traffic are not expected to increase the cost of shipping.

A summary of the estimated number of the small entities directly regulated by this amendment is shown in Table X. The numbers of commercial harvesters in that table cannot be summed to generate a total because one entity may hold a permit or fish in more than one fishery.

Table X: Estimated number of small entities that are directly regulated

Entity	Number of Small Entities	Number of Entities that are not Considered Small
Aquaculture Permit Holder	0	unknown
Shrimp Harvester	1,848	0
Reef Fish Harvester	945	0
Commercial Migratory Pelagic	1,514	0
Commercial Spiny Lobster (non-Florida/tailing)	132/299	0
Stone Crab Harvester	720	0
Charter/Headboats for Reef Fish	1,356	0
Charter/Headboats for Coastal Pelagics	1,348	0
Red Snapper	612	0
Swordfish (directed/incidental/handgear)	180/80/82	0
Shark (directed/incidental)	132/283	0
Water Transportation	?	?

8.5 Description of the Projected Reporting, Record-keeping, and Other Compliance Requirements of the Proposed Rule, Including an Estimate of the Classes of Small Entities which will be Subject to the Requirement and the Type of Professional Skills Necessary for the Preparation of the Report or Records

The proposed record-keeping and reporting and other compliance requirements are described in Section 4. Those alternatives are included here by reference. A summary of the alternatives is provided in this section. These requirements apply only to persons that are issued an aquaculture permit under the proposed action (aquaculture firms that would be developed in the Gulf) and not existing commercial harvester, buyers, or processors

1. *Obtain an assurance bond for the removal of aquaculture structures when an operation terminates.*
2. *Report to* NOAA Fisheries Service *the source of brood fish for fingerling production by geographic area*
3. *frequency broodstock are replaced*
4. *Report to* NOAA Fisheries Service *if cultured fish will be raised to sexual maturity*

5. *Report to* NOAA Fisheries Service *the identity of an animal health management expert that the firm consults and frequency of visits*
6. *Report to* NOAA Fisheries Service *procedures for notifying NOAA of reportable disease*
7. *Report to* NOAA Fisheries Service *procedures for prestocking health inspections of aquatic animals*
8. *Freeze or refrigerate diseased animals so they are available for inspection. "Diseased" animals are those infested with parasites and/or infected by bacteria or virus*
9. *Provide* NOAA Fisheries Service *a description of the culture facility, if spawning and rearing activities will occur at another location other than the culture facility*
10. *Report to* NOAA Fisheries Service *the number species, and size of brood fish proposed to be captured and the methods/gears used for capturing, holding, and transporting broodstock*
11. *Report to* NOAA Fisheries Service *anticipated size to which fingerlings will be raised*
12. *Report to* NOAA Fisheries Service *a list of names and addresses for spawning and rearing facilities used to obtain fingerlings and any relevant aquaculture permit numbers*
13. *Report to* NOAA Fisheries Service *a plan for minimizing interactions with threatened or endangered species*
14. *Report to* NOAA Fisheries Service *a description of how environmental impacts would be monitored*
15. *Report to* NOAA Fisheries Service compliance with EPA standards
16. Provide NOAA Fisheries Service with copies of state, ACOE and EPA permits and monitoring reports
17. *Report all fish landed or harvested from the facility to* NOAA Fisheries Service
18. *File reports with* NOAA Fisheries Service *upon diagnosis or suspicion of a reportable disease.* NOAA Fisheries Service *will designate those diseases that are reportable*
19. *Notify* NOAA Fisheries Service *of major escapement and reasons for escapement. Major escapement is defined as cumulative escapement of 10 percent or more of stocked fish.*
20. *Notify* NOAA Fisheries Service *of a reportable disease outbreak A reportable disease outbreak as defined by* NOAA Fisheries Service
21. *Notify* NOAA Fisheries Service *of entanglements or interactions with marine mammals, endangered species, or migratory birds*
22. *notify* NOAA Fisheries Service *of any changes in sources used for providing fingerlings*
23. *Keep copies of feed labels on file for three years from date of use*
24. *Keep all harvest and sale records for three years. Sale records should include the names of companies and individuals to whom fish are sold*
25. *Inform* NOAA Fisheries Service *when the type of aquaculture system used for culture is changed*
26. *Inform* NOAA Fisheries Service *of all species being cultured*
27. Applicant must *provide* names, addresses and phone numbers of captains and vessel owners, along with project vessel(s) documentation or identification numbers. As a condition for maintaining the permit the applicant agrees to notify NOAA Fisheries Service if there are any changes in company owners, captains and/or vessel owners;
28. Applicant must *describe* the exact location of the facilities and any associated pens or enclosures using GPS coordinates and the species of fish to be cultured;
29. Applicant must agree to *maintain* a minimum of one locating device on each pen or enclosure and immediately notify NOAA Fisheries Service in the event the pen or any retention aquaculture enclosure is lost at sea;

30. Permittee must *describe* the harvesting equipment necessary for operation and removal of aquaculture fish;
31. The aquaculture operational permit shall *specify* the conditions under which aquaculture harvesting gear or any type of fishing equipment shall be deployed, retrieved, and stored;
32. Permittee must *notify* NOAA Fisheries Service prior to removal and transport of aquaculture fish from the facility to shore;
33. Aquacultured fish must be maintained with heads and fins intact until reaching the processing facility.
34. Transport and service vessels, aircraft, and vehicles must have a copy of the aquaculture permit on board; and,
35. Other appropriate permit conditions, as specified by the NOAA Fisheries Service Regional Administrator, necessary for issuance and administration of an aquaculture permit.

Because the above record keeping and reporting requirements apply only to aquaculture firms, they are not expected to affect any small businesses. The total number of businesses (not small businesses) that would be affected cannot be estimated. The number will be determined by the number of businesses that are permitted to operate in the the Gulf of Mexico EEZ under this amendment. That number cannot be predicted and will not be known until firms apply for and are issued permits.

The professional skills necessary for the preparation of the reports or records would entail the use of computers to submit the reports electronically or complete forms provided by NOAA Fisheries Service. NOAA Fisheries Service would provide instructions for submitting the information using either method. However, the firms that are expected to comply with these requirements will likely have annual budgets of over $1 million. Firms of that size are anticipated to have employees that are computer literate and have computers with Internet access.

8.6 Identification of all Relevant Federal Rules, which may Duplicate, Overlap, or Conflict with the Proposed Rule

No duplicative, overlapping, or conflicting Federal rules have been identified. But overlapping authority does exist for a number of issues relevant to aquaculture.

8.7 Significance of the Economic Impacts on Small Entities

Aquaculture Permit Holders: As discussed in the RIR, no offshore finfish or shellfish aquaculture firms are expected to develop that would have average annual gross receipts of less than $750,000. Because none of these entities would be classified as “small” under the SBA definitions for finfish and shellfish farming there are not expected to be any significant economic impacts on small entities that hold an offshore aquaculture permit.

Commercial Harvesters: The economic impacts on small entities, resulting from permitting offshore aquaculture in the Gulf of Mexico EEZ, may be decreases in ex-vessel prices of species harvested in the commercial fisheries. Ex-vessel prices would be expected to decline if own-price and cross-price flexibilities are negative and production from Gulf aquaculture is not a perfect substitute for imported products. Negative price flexibilities imply that an increase in the

quantity of a species in the market would reduce ex-vessel prices. Assuming the quantity of each species produced by the commercial fishery is constant, the gross revenues of the harvesters would decline when the overall amount of substitute products increases. Having said this, however, price declines to commercial fishermen are likely to be strongly tied to the degree of substitutability of the domestic production from aquaculture to imports of a like species. One would expect that as the degree of substitutability between U.S. aquaculture production and imports increases, imports will decline in increasing amounts. If imported and domestic offshore aquaculture products are perfect substitutes (Gulf aquaculture production would replace an equivalent amount of imports), there is no price decline to the Gulf fishermen as a result of domestic aquaculture production. Instead, the decrease in ex-vessel price would be determined by the amount of product imported into the U.S.

While any product produced via offshore aquaculture is expected to be a close substitute for imported product, the lack of information precludes determining whether they would be perfect substitutes. Therefore, quantitative estimates of the change in ex-vessel revenue for wild production as a result of increasing domestic aquaculture supplies cannot be predicted. However, it is expected that combined the domestic and imported products will place downward pressure on the ex-vessel value of commercial harvests. The portion of the decrease in ex-vessel price associated with domestic production cannot be estimated at this time.

Aquaculture has the most potential to increase both domestic and foreign production. Foreign production from places like Asia and Latin America may have a significant impact on world supplies of these species in the future whether or not developing aquaculture technologies to produce these species are utilized in the Gulf of Mexico EEZ. Therefore, increases in world-wide aquaculture production are expected to reduce the ex-vessel prices received by commercial harvesters in the Gulf of Mexico (if market demand does not increase), and the reductions will likely occur whether or not offshore permits are developed via this amendment.

In addition to potential changes in ex-vessel price, the cost of harvesting fish could also potentially increase if preferred fishing areas are closed for aquaculture or the distance traveled when fishing is increased because of the placement of aquaculture facilities. However, neither of these costs are expected to increase by any appreciable amount due to the preferred alternatives selected by the Council. In terms of the site selection process for aquaculture facilities, NOAA Fisheries Service and the COE would review proposed aquaculture sites on a case-by-case basis using criteria established by various federal agencies. These criteria would include both specific and general specifications (e.g., do not site facilities where they would be a navigation hazard). These criteria could also establish areas where aquaculture could not occur (e.g., MPAs, HAPCs, other sensitive areas, important commercial fishing areas). The geographic area set-aside under aquaculture permits is expected to be relatively small. For example, in Hawai'i, the state leases 193 acres of offshore lands as part of three separate leases. Kona Blue Water Farms LLC holds one of those leases. If 50 aquaculture sites are developed at the size of those in Hawai'i, informal discussions with persons involved in the aquaculture industry have indicated that may be a reasonable estimate, then about 3,200 acres would be used for sites. Therefore it may be reasonable to assume that less than 4,000 acres would be set aside for aquaculture. Spreading those sites out around the Gulf would be expected to have little or no impact on the cost of travel for commercial fishing vessels.

The Council also selected as part of their preferred alternative (Action 7) to not restrict access around marine aquaculture facilities. Permit applicants are expected to request an area that is large enough to provide protection for their operation without monopolizing unnecessary space in the EEZ. NOAA will review the size of the site requested as part of their normal permit review process. It is anticipated that NOAA would request the permit applicant to modify their site request if it was too large or was in an area traditionally important to commercial (or recreational) fishing.

Charter and Headboats: Charter and headboat businesses are not expected to be significantly negatively impacted by offshore aquaculture. The costs for charter/headboat operations could, in theory, increase if they are precluded from fishing productive areas closer to their home port or they are required to travel farther to avoid transiting through restricted areas around aquaculture facilities. For reasons discussed in the commercial fisheries section, neither of these results are expected to significantly increase operational costs because of the preferred alternatives selected by the Council. NOAA fisheries, the COE, and other agencies will be tasked with reviewing sites to ensure they do not (1) cause conflicts with historic areas important to harvesting wild stocks, (2) interfere with shipping fairways, or (3) result in negative impacts on the environment.

Shipping and Transportion: Because of the proposed permitting process, size of aquaculture sites, and number of sites that are expected to develop, allowing only permitted vessels to have access to aquaculture areas is not expected to the increase the costs of shipping and transportation vessels. The Minerals Management Service provides a map that shows major shipping fairways (in addition to other multiple use areas) in the Gulf. The detail in that map is too small to provide useful information when reduced to fit in this document, but the map can be found at http://www.gomr.mms.gov/homepg/lsesale/Visual2.pdf. The major shipping fairways reported in that map would not be suitable candidates for an aquaculture site and it is not expected that the COE would approve a permit that is requested in those areas.

8.8 Description of Significant Alternatives to the Proposed Rule and Discussion of How the Alternatives Attempt to Minimize Economic Impacts on Small Entities

Section 7 of this document provides an economic analysis of the alternatives under consideration in this amendment package. The most significant alternative under consideration is whether to create permits for offshore aquaculture in the Gulf of Mexico. The remaining alternatives define the regulatory structure for issuing the permits and monitoring the activity resulting from those permits. The regulations considered are developed to ensure the quality of the ecosystem is maintained while placing the minimum burden necessary on the aquaculture firms and other users of Gulf waters. Those actions apply to aquaculture firms that are not defined as small entities by the SBA. Only two of the actions would directly regulate commercial harvesters, charter/headboat operations, and commercial water transportation. **Action 6** defines the site permitting process and **Action 7** addresses whether buffer zones around the sites are needed. As discussed earlier the firms in the commercial and charter/headboat sectors are considered small entities. Information is not available to determine the number and size of entities involved in water transportation.

Development of offshore aquaculture requires the production facility to have restricted access to the portion of the ocean where they operate. The exclusive use of an area means that the offshore aquaculture firms will compete for space in federal waters with other activities, such as recreational fishing, commercial fishing, and shipping. Conflicts between aquaculture firms and commercial or recreational fishers could arise if the aquaculture site is a desirable fishing area or if the site attracts fish (see Section 6.1.5.1).

The two alternatives that directly regulate small entities are discussed next. Four alternatives were considered under **Action 6** to designate sites or areas for aquaculture. **Alternative 2** would establish marine aquaculture areas. These pre-permitted areas could be used for marine aquaculture. The Council also considered sub-options that other uses of the area would either be restricted or not restricted. The sub-option that would have restricted access to these larger areas set aside for aquaculture use would have had greater impact on commercial harvesters and charter/headboat operators in the Gulf, because larger areas would have been closed. The Council considered this alternative because pre-approving areas for aquaculture may reduce the time required for approving a permit application. The Council elected not to select this alternative because the benefits that might result through a shorter permitting process were more than offset by the negative impacts of closing more area than needed for the aquaculture firms to operate.

Alternative 1, Alternative 3, and Alternative 4 would not designate areas in the Gulf of Mexico EEZ where aquaculture would be allowed. Those alternatives differ in that under **Alternative 1** The Army Corp of Engineers (ACOE) would permit sites for aquaculture. NOAA Fisheries Service and the Council would continue to review and comment on ACOE siting permits. **Alternative 3** would establish criteria for siting marine aquaculture facilities the complete list of these criteria may be found in table 6.7-1. The criteria important to the commercial harvesters and charter/headboat operators are that aquaculture sites would be restricted from:

- Federally recognized marine reserve, marine protected area, habitat area of particular concern, government or public artificial reefs;
- Ecologically important habitat (e.g., coral reefs, hard bottom)
- Traditionally important fishing areas
- Seagrass beds
- Important nursery habitat; known spawning areas.

The list of criteria indicates that aquaculture sites would not be approved in shipping fairways, navigational channels, federal channels, anchoring areas, or lightering areas.

Preferred Alternative 4 would establish general siting criteria to be applied on a case-by-case basis to ensure reliable offshore growing system technology is used to provide environmental safeguards. Siting criteria would include, but not be limited to the items in Table 6.7-1, and the requirements of ACOE, MMS, EPA, NOAA Fisheries Service, and other regulatory agencies with authority in the EEZ as applied to aquaculture. This alternative would limit competition between aquaculture firms and other fishers for important historic fishing areas and would provide safeguards for areas that are critical to the spawning and growth of wild stocks.

By selecting **Alternative 4** as the preferred alternative, the area exclusively reserved for offshore aquaculture would be minimized. Aquaculture sites would be permitted based on the actual area needed for the facility to efficiently operate and away from areas that are most valuable to other users. Excess area would not be closed as a set-aside for future aquaculture facilities. Because the sites would be located where they have the least impact on fishers access to wild stocks, the conflicts between commercial and recreational fishers and the aquaculture industry would be minimized.

Action 7 would establish buffer zones for marine aquaculture facilities. **Preferred Alternative 1** does not restrict access around marine aquaculture facilities. Applicants would need to request an aquaculture site that is large enough to allow them to setup their infrastructure and have enough of a boundary to prevent others from tampering with their equipment and stock. **Alternative 2** would create buffer zones for marine aquaculture facilities that within the boundaries of which, fishing and fishing vessels would be prohibited. The buffer zones were determined to be unnecessary because businesses should account for their site security in their site application. If the site contains sufficient boundaries to prevent tampering, including an additional buffer zone would close more area than is needed for the aquaculture firm to operate.

Because the Council selected the alternative that would minimize the area closed to other persons, it should minimize the negative economic impacts on commercial harvesters, charter/headboat operations, and the shipping and transport industry.

9.0 Other Applicable Laws

The MSFCMA (16 U.S.C. 1801 et seq.) provides the authority for fishery management in federal waters of the EEZ. However, fishery management decision-making is also affected by a number of other federal statutes designed to protect the biological and human components of U.S. fisheries, as well as the ecosystems within which those fisheries are conducted. This Generic Aquaculture Amendment is an integrated document that includes analyses necessary for the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act (RFA), and Executive Order 12866.

NEPA requires all federal actions to evaluate environmental impacts of proposed actions, and for those impacts to be assessed and reported to the public. For this amendment, the Council conducted an EIS. The primary purpose of an EIS is "to provide full and fair discussion of significant environmental impacts to inform decision makers and the public of reasonable alternatives, which would avoid or minimize adverse impacts or enhance the quality of the human environment (Part 1502.1 CEQ)." Part 1502.2 of the CEQ regulations specifies how agencies should prepare an EIS to achieve the above stated purpose.

The RFA requires federal agencies to assess the impacts of regulatory actions implemented through notice and comment rulemaking procedures on small businesses, small organizations, and small governmental entities, with the goal of minimizing adverse impacts of burdensome regulations and record-keeping requirements on those entities. These analyses, which describe the type and number of small businesses affected, are provided in Section 8.0. These analyses are published in the *Federal Register* in full or in summary for public comment and submitted to the chief counsel for advocacy of the Small Business Administration.

To comply with E.O. 12866, NOAA Fisheries prepares an RIR for all fishery regulatory actions that either implement a new fishery management plan or significantly amend an existing plan. RIRs provide a comprehensive analysis of the costs and benefits to society associated with proposed regulatory actions, the problems and policy objectives prompting the regulatory proposals, and the major alternatives that could be used to solve the problems. These analyses can be found in Section 7.0 of this amendment.

Other major laws affecting federal fishery management decision-making are summarized below.

9.1 Administrative Procedures Act

All federal rulemaking is governed under the provisions of the Administrative Procedure Act (APA) (5 U.S.C. Subchapter II), which establishes a "notice and comment" procedure to enable public participation in the rulemaking process. Under the APA, NOAA Fisheries is required to publish notification of proposed rules in the *Federal Register* and to solicit, consider and respond to public comment on those rules before they are finalized. The APA also establishes a 30-day wait period from the time a final rule is published until it takes effect.

9.2 Coastal Zone Management Act

Section 307(c)(1) of the federal Coastal Zone Management Act (CZMA) of 1972, as amended, requires federal activities affecting any land or water use or natural resource of a state's coastal zone be conducted in a manner consistent, to the maximum extent practicable, with approved state coastal management programs. The requirements for such a consistency determination are set forth in NOAA regulations at 15 C.F.R. part 930, subpart C. When proposing an action determined to directly affect coastal resources managed under an approved coastal zone management program, NOAA Fisheries is required to provide the relevant state agency with a determination that the proposed action is consistent with the enforceable policies of the approved program to the maximum extent practicable at least 90 days before taking final action. NOAA Fisheries and the Council have determined this action is consistent with the Coastal Zone Management programs of the states of Alabama, Florida, Louisiana, Mississippi, and Texas to the maximum extent possible. This determination has been submitted to the responsible state agencies under Section 307 of the CZMA.

9.3 Data Quality Act

The Data Quality Act (DQA) (Public Law 106-443), effective October 1, 2002, requires the government to set standards for the quality of scientific information and statistics used and disseminated by federal agencies. Specifically, the Act directs the Office of Management and Budget (OMB) to issue government wide guidelines that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by federal agencies." Such guidelines have been issued, directing all federal agencies to create and disseminate agency-specific standards to: (1) ensure information quality and develop a pre-dissemination review process; (2) establish administrative mechanisms allowing affected persons to seek and obtain correction of information; and (3) report periodically to OMB on the number and nature of complaints received. Pursuant to

Section 515 of Public Law 106-554, this information document has undergone a pre-dissemination review by the Southeast Regional Office Sustainable Fisheries Division and is available from the agency.

9.4 Endangered Species Act

The Endangered Species Act (ESA) of 1973, as amended, (16 U.S.C. Section 1531 et seq.) requires that federal agencies use their authorities to conserve endangered and threatened species. The ESA requires NOAA Fisheries, when proposing a fishery action that "may affect" critical habitat or endangered or threatened species, to consult with the appropriate administrative agency (itself for most marine species, the USFWS for all remaining species) to determine the potential impacts of the proposed action. Consultations are concluded informally when proposed actions "may affect, but are not likely to adversely affect" endangered or threatened species or designated critical habitat. Formal consultations, including a biological opinion, are required when proposed actions may affect and are "likely to adversely affect" endangered or threatened species or adversely modify designated critical habitat. If jeopardy or adverse modification is found, the consulting agency is required to suggest reasonable and prudent alternatives.

9.5 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act (33 U.S.C 403) prohibits the creation of structures not authorized by Congress that obstruct navigable waters of the United States. The Act provides the Chief of Engineers and Secretary of War authority to authorize the building of structures in any port, roadstead, haven, harbor, canal, navigable river, or other water of the United States, outside established harbor lines, or where no harbor lines have been established. Title 33 CFR Section 322 prescribes the policies, practices, and procedures the Corps of Engineers follows when reviewing permits to authorize certain structures or work affecting navigable waters of the United States.

9.6 Clean Water Act

The Clean Water Act (CWA) (33 *U.S.C.* 1251-1387) is intended to maintain and restore waters of the United States. The CWA authorizes water quality and pollution research, provides grants for sewage treatment facilities, sets pollution discharge and water quality standards, addresses oil and hazardous substances liability, and establishes permit programs for water quality, point source pollutant discharges, ocean pollution discharges, and dredging or filling of wetlands or waters of the United States. The U.S. Army Corps of Engineers (USACE) and the EPA both have permitting authority under the CWA.

Title 40 CFR Parts 122-124 implement the EPA's National Pollution Elimination Discharge System (NPDES) Program under sections 318, 402, and 405 of the CWA. Water quality and effluent standards and criteria for the NPDES are described in 40 CFR, Parts 125, 129, 133, 136, 400-471, and 503. The EPA also published a final rule on August 23, 2004 (69 F.R. 162) establishing CWA effluent limitations, guidelines, and new point source pollution standards for concentrated aquatic animal production facilities, including facilities that produce 100,000 pounds or more per year of aquatic animals in net pens or submerged cage systems.

Pursuant to Section 404 of the CWA, the Army Corps of Engineers has authority to issue permits regulating the discharge of dredged or fill material into U.S. waters. Title 33 CFR Section 323 prescribes the policies, practices, and procedures the Corps of Engineers follows when reviewing permits to authorize the discharge of dredged or fill material. The intent of the CWA Section 404 program and its 404(b)(1) guidelines is to prevent destruction of aquatic ecosystems unless the action will not individually or cumulatively adversely affect the ecosystem. NOAA Fisheries may provide comments to the U.S. ACOE regarding impacts to marine resources of proposed activities and can recommend methods for avoiding such impacts.

9.7 National Marine Sanctuaries Act

The National Marine Sanctuaries Act (NMSA) (16 U.S.C. 1431 et seq.) directs the Secretary of Commerce to designate and manage areas of the marine environment with nationally significant aesthetic, ecological, historical, or recreational values as national marine sanctuaries. Regulations implementing the NMSA can be found at 15 CFR Part 922. These regulations serve to safeguard resources within sanctuary boundaries and include prohibitions or limitations on some activities, such as discharge and disturbance of the seabed. These regulations also provide the National Marine Sanctuary Program with authority to issue permits to allow certain activities beneficial to sanctuaries that would otherwise be prohibited.

9.8 National Invasive Species Act

This act reauthorized and amended the Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646). The act was originally passed in response to the zebra mussel invasion of the Great Lakes and required ships heading for the Great Lakes to exchange their ballast water at sea. In 1996, the act was reauthorized and all vessels arriving from outside the 200-mile U.S. EEZ were encouraged to exchange their ballast water. The Act requires all ships report whether or not they exchanged their ballast water.

9.9 National Aquaculture Act

The National Aquaculture Act was implemented in 1980. The purpose of the Act is to promote aquaculture in the United States by: 1) declaring a national aquaculture policy; 2) establishing and implementing a national aquaculture development plan; 3) establishing the Department of Agriculture as the lead Federal agency with respect to the coordination and dissemination of national aquaculture information; and 4) encouraging aquaculture activities and programs in both the public and private sectors of the economy. The act states "aquaculture has the potential for reducing the United States trade deficit in fisheries products, for augmenting existing commercial and recreational fisheries and for producing other renewable resources, thereby assisting the United States in meeting its future food needs and contributing to the solution of world resource problems." The act also established the Joint Subcommittee on Aquaculture (JSA). The JSA coordinates federal government activities relating to aquaculture.
The National Aquaculture Improvement Act amended this Act in 1985 and designated the Secretary of Agriculture as the permanent chair of the JSA. The secretaries of Commerce, Agriculture, and Interior comprise the JSA Executive Committee.

9.10 Outer Continental Shelf Lands Act

The Outer Continental Shelf Lands Act (OCSLA) was created in 1953. The Act defined the Outer Continental Shelf as all submerged lands between the seaward extent of state coastal waters and the seaward extent of federal jurisdiction. The purpose of the Act was to assure national security and reduce dependence on foreign sources. The Secretary of the Interior is responsible for the administration of mineral exploration and development of the OCS. The Act provides the Secretary of the Interior authority to grant leases through competitive bids and to promulgate regulations consistent with the provisions of the Act. The 1978 amendments to the Act provided for cancellation of leases or permits if continued activity is likely to cause serious harm to life, including aquatic life. These amendments also stipulated that economic, social, and environmental values of renewable and nonrenewable resources are to be considered in managing the OCS.

9.11 National Sea Grant College and Program Act

The National Sea Grant College and Program Act was established in 1966, and has been subsequently amended several times. The act authorized the establishment of sea grant colleges and programs. The intent of the Act was to initiate and support educational and research programs related to the development of marine resources. Aquaculture was one of the few fields of research specifically identified by the Act and Sea Grant has provided more support to aquaculture than any other area of research. The Act declared that aquaculture could substantially benefit the U.S. by providing greater economic opportunities, new sources of food, and new means for the development of marine resources. In 1976, the Act was amended and Sea Grant became a part of NOAA.

9.12 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 *U.S.C.* 661-666c) requires wildlife, including fish, receive equal consideration and be coordinated with other aspects of water resource development. This is accomplished via consultation with the U.S. Fish and Wildlife Service, NOAA Fisheries and appropriate state agencies, whenever any body of water is proposed to be modified in any way and a Federal permit or license is required. These agencies determine: (1) the possible harm to fish and wildlife resources; (2) the measures needed to both prevent the damage to and loss of these resources; and (3) the measures needed to develop and improve the resources, in connection with water resource development.

9.13 Executive Orders

9.13.1 E.O. 11987: Exotic Organisms

This Executive Order requires Federal agencies, to the extent permitted by law, to: 1) restrict the introduction of exotic species into the natural ecosystems on lands and waters owned or leased by the United States; 2) encourage states, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the U.S.; 3) restrict the importation and introduction of exotic species into any natural U.S. ecosystems as a result of activities they undertake, fund, or authorize; and 4) restrict the use of Federal funds, programs, or authorities to

export native species for introduction into ecosystems outside the U.S. where they do not occur naturally. The Secretaries of Agriculture and Interior are authorized to allow the importation of exotics and the export of native species if natural ecosystems will not be adversely affected.

9.13.2 E.O. 12866: Regulatory Planning and Review

Executive Order 12866: Regulatory Planning and Review, signed in 1993, requires federal agencies to assess the costs and benefits of their proposed regulations, including distributional impacts, and to select alternatives that maximize net benefits to society. Section 5.0 herein, provides a comprehensive analysis of the costs and benefits to society of proposed action.

9.13.3 E.O. 12630: Takings

The Executive Order on Government Actions and Interference with Constitutionally Protected Property Rights that became effective March 18, 1988, requires that each federal agency prepare a Takings Implication Assessment for any of its administrative, regulatory, and legislative policies and actions that affect, or may affect, the use of any real or personal property. Clearance of a regulatory action must include a takings statement and, if appropriate, a Takings Implication Assessment. A takings implication assessment will be prepared at the appropriate time.

9.13.4 E.O. 13089: Coral Reef Protection

The Executive Order on Coral Reef Protection requires federal agencies whose actions may affect U.S. coral reef ecosystems to identify those actions, utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and, to the extent permitted by law, ensure that actions that they authorize, fund or carry out do not degrade the condition of that ecosystem. There are no implications to coral reefs by the action proposed.

9.13.5 E.O. 13112: Invasive Species

The Executive Order on invasive species established an Invasive Species Council and specified the duties of federal agencies whose actions may affect the status of invasive species. The Order requires federal agencies to use relevant programs and authorities to 1) prevent the introduction of invasive species, 2) detect and respond rapidly to control the spread of such species, 3) monitor invasive species populations accurately and reliably, 4) provide for restoration of native species and habitat conditions in ecosystems that have been invaded, 5) conduct research to prevent introduction, and 6) promote education on invasive species. The Invasive Species Council oversees the implementation of the order, has prepared an invasive species management plan, develops guidance to federal agencies, and encourages planning and action at local, regional, and national levels.

9.13.6 E.O. 13132: Federalism

The Executive Order on Federalism requires agencies in formulating and implementing policies, to be guided by the fundamental Federalism principles. The Order serves to guarantee the division of governmental responsibilities between the national government and the states. No

Federalism issues have been identified relative to the proposed action. Therefore, preparation of a Federalism assessment under Executive Order 13132 is not necessary.

9.13.7 E.O. 13158: Marine Protected Areas

This Executive Order requires federal agencies to consider whether their proposed action(s) will affect any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural or cultural resource within the protected area. This action would have no impacts to marine protected areas.

9.13.8 E.O. 12898: Federal Actions to Address Environmental Justice in Minority and Low-Income Populations

This Executive Order requires federal agencies conduct their programs, policies, and activities in a manner to ensure individuals or populations are not excluded from participation in, or denied the benefits of, or subjected to discrimination because of their race, color, or national origin. In addition, and specifically with respect to subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. Impacts of aquaculture and commercial fishing on subsistence fishing are a concern in fisheries management; however, there are no such implications from the action proposed in this amendment.

9.14 Marine Mammal Protection Act

The MMPA established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the United States. Under the MMPA, the Secretary of Commerce (authority delegated to NOAA Fisheries) is responsible for the conservation and management of cetaceans and pinnipeds (other than walruses). The Secretary of the Interior is responsible for walruses, sea and marine otters, polar bears, manatees, and dugongs.

Part of the responsibility that NOAA Fisheries has under the MMPA involves monitoring populations of marine mammals to make sure they stay at optimum levels. If a population falls below its optimum level, it is designated as “depleted,” and a conservation plan is developed to guide research and management actions to restore the population to healthy levels.

In 1994, Congress amended the MMPA, to govern the taking of marine mammals incidental to commercial fishing operations. This amendment required the preparation of stock assessments for all marine mammal stocks in waters under U.S. jurisdiction, development and implementation of take reduction plans for stocks that may be reduced or are being maintained below their optimum sustainable population levels due to interactions with commercial fisheries, and studies of pinniped-fishery interactions.

9.15 Paperwork Reduction Act

The Paperwork Reduction Act (PRA) of 1995 (44 U.S.C. 3501 et seq.) regulates the collection of public information by federal agencies to ensure that the public is not overburdened with information requests, that the federal government's information collection procedures are efficient, and that federal agencies adhere to appropriate rules governing the confidentiality of such information. The PRA requires NOAA Fisheries to obtain approval from the Office of Management and Budget before requesting most types of fishery information from the public.

9.16 Small Business Act

The Small Business Act of 1953, as amended, Section 8(a), 15 U.S.C. 634(b)(6), 636(j), 637(a) and (d); Public Laws 95-507 and 99-661, Section 1207; and Public Laws 100-656 and 101-37 are administered by the Small Business Administration. Because most businesses associated with fishing are considered small businesses, NOAA Fisheries, must make an assessment of how those regulations will affect small businesses. Implications to small businesses are discussed in Section X, herein.

9.17 Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Provisions

The amended MSFCMA requires adverse effects to EFH caused by fishing be minimized to the extent practicable and identify other actions to encourage the conservation and enhancement of that EFH. Each existing, and any new FMPS must describe and identify EFH for the fishery, minimize to the extent practicable adverse effects on that EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of that EFH. Under separate action, the Council approved a Generic EFH Amendment, including an EIS, during January 2005. The EFH Amendment describes and identifies EFH for Gulf fisheries; (2) identifies other actions to encourage the conservation and enhancement of such EFH; and (3) identify measures to minimize to the extent practicable the adverse effects of fishing on such EFH. The actions proposed within this amendment that effect EFH will be reviewed on a case-by-case basis to determine the range of potential impacts on EFH as indicated in Section 4 and 6 under siting criteria (Action 6).

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11.0 List of Preparers

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12.0 List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

Gulf of Mexico Fishery Management Council

Law Enforcement Advisory Panel
Standing Scientific and Statistical Committee (SSC)
Ad Hoc Aquaculture Advisory Panel

Other Agencies, Organizations, or Persons

Alabama Cooperative Extension Service
Alabama Department of Conservation and Natural Resources, Marine Resources Division
Florida Fish and Wildlife Conservation Commission
Florida Sea Grant
Louisiana Cooperative Extension Service
Louisiana Department of Wildlife and Fisheries
Mineral Management Service
Mississippi Cooperative Extension Service
Mississippi Department of Marine Resources
NOAA Fisheries Service Southeast Regional Office
NOAA Fisheries Service Southeast Fisheries Science Center
NOAA Fisheries Service Silver Spring Office
NOAA Fisheries Service Law Enforcement
Texas Cooperative Extension Service
Texas Parks and Wildlife Department
United States Coast Guard
United States Environmental Protection Agency
United States Fish and Wildlife Service
United States Food and Drug Administration

Public Hearing Locations and Dates

July 9, 2007	Best Western	7921 Lamar Poole Rd	Biloxi	MS	39532	228-875-7111
July 9, 2007	Doubletree Beach Resort	17120 Gulf Blvd.	N. Reddington Beach	FL	33708	727-391-4000
July 10, 2007	W Hotel New Orleans	333 Poydras St	New Orleans	LA	70130	504-525-9444
July 10, 2007	City of Orange Beach Rec. Ctr	27235 Canal Rd	Orange Beach	AL	36561	251-981-6028
July 11, 2007	San Luis	5222 Seawall Blvd.	Galveston	TX	77550	409-744-1500
July 11, 2007	Embassy Suites Hotel	570 Scenic Gulf Drive	Destin	FL	32550	850-337-7000
July 12, 2007	Best Western Marina Grand	300 N. Shoreline Blvd.	Corpus Christi	TX	78401	361-883-5111

December 10, 2007	Comfort Inn North	2260 54th Ave. N.	St. Petersburg	FL	33714	727-362-0075
December 10, 2007	Hilton Hobby Airport	8181 Airport Blvd.	Houston	TX	77061	713-645-3000
December 11, 2007	Hilton Airport	901 Airline Drive	New Orleans	LA	70062	504-469-5000
December 12, 2007	Wingate Inn	12009 Indian River Rd.	Biloxi	MS	39540	228-396-0036
December 13, 2007	Ashbury Hotel	600 S. Beltline Hwy.	Mobile	AL	36608	251-344-8030

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15.0 Figures

(Note if receiving this document electronically, the figures are saved in a separate file.)

APPENDIX A - NMFS EXEMPTED FISHING PERMIT* 50CFR 600.745

Sec. 600.745 Scientific research activity, exempted fishing, and exempted educational activity.

(a) Scientific research activity. Nothing in this section is intended to inhibit or prevent any scientific research activity conducted by a scientific research vessel. Persons planning to conduct scientific research activities in the EEZ are encouraged to submit to the appropriate Regional Administrator, Director, or designee, 60 days or as soon as practicable prior to its start, a scientific research plan for each scientific cruise. The Regional Administrator, Director, or designee will acknowledge notification of scientific research activity by issuing to the operator or master of that vessel, or to the sponsoring institution, a letter of acknowledgment. This letter of acknowledgment is separate and distinct from any permit required by any other applicable law. If the Regional Administrator, Director, or designee, after review of a research plan, determines that it does not constitute scientific research but rather fishing, the Regional Administrator, Director, or designee will inform the applicant as soon as practicable and in writing. The Regional Administrator, Director, or designee may also make recommendations to revise the research plan to make the cruise acceptable as scientific research activity or recommend the applicant request an EFP. In order to facilitate identification of activity as scientific research, persons conducting scientific research activities are advised to carry a copy of the scientific research plan and the letter of acknowledgment on board the scientific research vessel. Activities conducted in accordance with a scientific research plan acknowledged by such a letter are presumed to be scientific research activity. The presumption may be overcome by showing that an activity does not fit the definition of scientific research [[Page 83]] activity or is outside the scope of the scientific research plan.

(b) Exempted fishing.--(l) General. A NMFS Regional Administrator or Director may authorize, for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited. Exempted fishing may not be conducted unless authorized by an EFP issued by a Regional Administrator or Director in accordance with the criteria and procedures specified in this section. The Regional Administrator or Director may charge a fee to recover the administrative expenses of issuing an EFP. The amount of the fee will be calculated, at least annually, in accordance with procedures of the NOAA Handbook for determining administrative costs of each special product or service; the fee may not exceed such costs. Persons may contact the appropriate Regional Administrator or Director to find out the applicable fee. (2) Application. An applicant for an EFP shall submit a completed application package to the appropriate Regional Administrator or Director, as soon as practicable and at least 60 days before the desired effective date of the EFP. Submission of an EFP application less than 60 days before the desired effective date of the EFP may result in a delayed effective date because of review requirements.

*Regulates Scientific Aquaculture

The application package must include payment of any required fee as specified by paragraph (b)(1) of this section, and a written application that includes, but is not limited to, the following information: (i) The date of the application. (ii) The applicant's name, mailing address, and telephone number. (iii) A statement of the purposes and goals of the exempted fishery for which an EFP is needed, including justification for issuance of the EFP. (iv) For each vessel to be covered by the EFP, as soon as the information is available and before operations begin under the EFP: (A) A copy of the USCG documentation, state license, or registration of each vessel, or the information contained on the appropriate document. (B) The current name, address, and telephone number of the owner and master, if not included on the document provided for the vessel. (v) The species (target and incidental) expected to be harvested under the EFP, the amount(s) of such harvest necessary to conduct the exempted fishing, the arrangements for disposition of all regulated species harvested under the EFP, and any anticipated impacts on marine mammals or endangered species. (vi) For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used. (vii) The signature of the applicant. (viii) The Regional Administrator or Director, as appropriate, may request from an applicant additional information necessary to make the determinations required under this section. An incomplete application or an application for which the appropriate fee has not been paid will not be considered until corrected in writing and the fee paid. An applicant for an EFP need not be the owner or operator of the vessel(s) for which the EFP is requested. (3) Issuance. (i) The Regional Administrator or Director, as appropriate, will review each application and will make a preliminary determination whether the application contains all of the required information and constitutes an activity appropriate for further consideration. If the Regional Administrator or Director finds that any application does not warrant further consideration, both the applicant and the affected Council(s) will be notified in writing of the reasons for the decision. If the Regional Administrator or Director determines that any application warrants further consideration, notification of receipt of the application will be published in the Federal Register with a brief description of the proposal, and the intent of NMFS to issue an EFP. Interested persons will be given a 15- to 45-day opportunity to comment and/or comments will be requested during public testimony at a Council meeting. The notification may establish a cut-off date for [[Page 84]] receipt of additional applications to participate in the same, or a similar, exempted fishing activity. The Regional Administrator or Director also will forward copies of the application to the Council(s), the USCG, and the appropriate fishery management agencies of affected states, accompanied by the following information: (A) The effect of the proposed EFP on the target and incidental species, including the effect on any TAC. (B) A citation of the regulation or regulations that, without the EFP, would prohibit the

proposed activity. (C) Biological information relevant to the proposal, including appropriate statements of environmental impacts, including impacts on marine mammals and threatened or endangered species. (ii) If the application is complete and warrants additional consultation, the Regional Administrator or Director may consult with the appropriate Council(s) concerning the permit application during the period in which comments have been requested. The Council(s) or the Administrator or Regional Administrator shall notify the applicant in advance of any meeting at which the application will be considered, and offer the applicant the opportunity to appear in support of the application. (iii) As soon as practicable after receiving responses from the agencies identified in paragraph (b)(3)(i) of this section, and/or after the consultation, if any, described in paragraph (b)(3)(ii) of this section, the Regional Administrator or Director shall notify the applicant in writing of the decision to grant or deny the EFP, and, if denied, the reasons for the denial. Grounds for denial of an EFP include, but are not limited to, the following: (A) The applicant has failed to disclose material information required, or has made false statements as to any material fact, in connection with his or her application; or (B) According to the best scientific information available, the harvest to be conducted under the permit would detrimentally affect the well-being of the stock of any regulated species of fish, marine mammal, or threatened or endangered species in a significant way; or (C) Issuance of the EFP would have economic allocation as its sole purpose; or (D) Activities to be conducted under the EFP would be inconsistent with the intent of this section, the management objectives of the FMP, or other applicable law; or (E) The applicant has failed to demonstrate a valid justification for the permit; or (F) The activity proposed under the EFP could create a significant enforcement problem. (iv) The decision of a Regional Administrator or Director to grant or deny an EFP is the final action of NMFS. If the permit, as granted, is significantly different from the original application, or is denied, NMFS may publish notification in the Federal Register describing the exempted fishing to be conducted under the EFP or the reasons for denial. (v) The Regional Administrator or Director may attach terns and conditions to the EFP consistent with the purpose of the exempted fishing, including, but not limited to: (A) The maximum amount of each regulated species that can be harvested and landed during the teuii of the EFP, including trip limitations, where appropriate. (B) The number, size(s), name(s), and identification number(s) of the vessel(s) authorized to conduct fishing activities under the EFP. (C) The time(s) and place(s) where exempted fishing may be conducted. (D) The type, size, and amount of gear that may be used by each vessel operated under the EFP. (E) The condition that observers, a vessel monitoring system, or other electronic equipment be carried on board vessels operated under an EFP, and any necessary conditions, such as pre-deployment notification requirements. (F) Reasonable data reporting requirements. (G) Other conditions as may be necessary to assure compliance with the purposes of the EFP, consistent with the objectives of the FMP and other applicable law. (H) Provisions for public release of data obtained under the EFP that are [[Page 85]] consistent with NOAA confidentiality of statistics procedures at set out in subpart E. An applicant may be required to waive the right to confidentiality of information gathered while conducting exempted fishing as a condition of an EFP. (4) Duration. Unless otherwise specified in the EFP or a superseding notice or regulation, an EFP is effective for no longer than 1 year, unless revoked, suspended or modified. EFPs may be renewed following the application procedures in this section. (5) Alteration. Any permit that has been altered, erased, or

mutilated is invalid. (6) Transfer. EFPs issued under this section are not transferable or assignable. An EFP is valid only for the vessel(s) for which it is issued. (7) Inspection. Any EFP issued under this section must be carried on board the vessel(s) for which it was issued. The EFP must be presented for inspection upon request of any authorized officer. (8) Sanctions. Failure of a permittee to comply with the terns and conditions of an EFP may be grounds for revocation, suspension, or modification of the EFP with respect to all persons and vessels conducting activities under the EFP. Any action taken to revoke, suspend, or modify an EFP for enforcement purposes will be governed by 15 CFR part 904, subpart D. (c) Reports. (1) Persons conducting scientific research activity are requested to submit a copy of any cruise report or other publication created as a result of the cruise, including the amount, composition, and disposition of their catch, to the appropriate Science and Research Director. (2) Persons fishing under an EFP are required to report their catches to the appropriate Regional Administrator or Director, as specified in the EFP. (d) Exempted educational activities--(l) General. A NMFS Regional Administrator or Director may authorize, for educational purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited. The decision of a Regional Administrator or Director to grant or deny an exempted educational activity authorization is the final action of NMFS. Exempted educational activities may not be conducted unless authorized in writing by a Regional Administrator or Director in accordance with the criteria and procedures specified in this section. Such authorization will be issued without charge. (2) Application. An applicant for an exempted educational activity authorization shall submit to the appropriate Regional Administrator or Director, at least 15 days before the desired effective date of the authorization, a written application that includes, but is not limited to, the following information: (i) The date of the application. (ii) The applicant's name, mailing address, and telephone number. (iii) A brief statement of the purposes and goals of the exempted educational activity for which authorization is requested, including a general description of the arrangements for disposition of all species collected. (iv) Evidence that the sponsoring institution is a valid educational institution, such as accreditation by a recognized national or international accreditation body. (v) The scope and duration of the activity. (vi) For each vessel to be covered by the authorization: (A) A copy of the U.S. Coast Guard documentation, state license, or registration of the vessel, or the information contained on the appropriate document. (B) The current name, address, and telephone number of the owner and master, if not included on the document provided for the vessel. (vii) The species and amounts expected to be caught during the exempted educational activity. (viii) For each vessel covered by the authorization, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used. (ix) The signature of the applicant. (x) The Regional Administrator or Director may request from an applicant additional information necessary to make the determinations required [[Page 86]] under this section. An incomplete application will not be considered until corrected in writing. (3) Issuance. (i) The Regional Administrator or Director, as appropriate, will review each application and will make a determination whether the application contains all of the required information, is consistent with the goals, objectives, and requirements of the FMP or regulations and other applicable law, and constitutes a valid exempted educational activity. The applicant will be notified in writing of the decision within 5 working days of receipt of the application. (ii) The Regional Administrator or Director may attach terms and conditions to

the authorization, consistent with the purpose of the exempted educational activity, including, but not limited to: (A) The maximum amount of each regulated species that may be harvested. (B) The time(s) and place(s) where the exempted educational activity may be conducted. (C) The type, size, and amount of gear that may be used by each vessel operated under the authorization. (D) Reasonable data reporting requirements. (E) Such other conditions as may be necessary to assure compliance with the purposes of the authorization, consistent with the objectives of the FMP or regulations. (F) Provisions for public release of data obtained under the authorization, consistent with NOAA confidentiality of statistics procedures in subpart E. An applicant may be required to waive the right to confidentiality of information gathered while conducting exempted educational activities as a condition of the authorization. (iii) The authorization will specify the scope of the authorized activity and will include, at a minimum, the duration, vessel(s), species and gear involved in the activity, as well as any additional terms and conditions specified under paragraph (d)(3)(ii) of this section. (4) Duration. Unless otherwise specified, authorization for an exempted educational activity is effective for no longer than 1 year, unless revoked, suspended, or modified. Authorizations may be renewed following the application procedures in this section. (5) Alteration. Any authorization that has been altered, erased, or mutilated is invalid. (6) Transfer. Authorizations issued under this paragraph (d) are not transferable or assignable. (7) Inspection. Any authorization issued under this paragraph (d) must be carried on board the vessel(s) for which it was issued or be in possession of the applicant to which it was issued while the exempted educational activity is being conducted. The authorization must be presented for inspection upon request of any authorized officer. Activities that meet the definition of fishing, despite an educational purpose, are fishing. An authorization may allow covered fishing activities; however, fishing activities conducted outside the scope of an authorization for exempted educational activities are illegal. [61 FR 32540, June 24, 1996, as amended at 63 FR 7075, Feb. 12, 1998].

APPENDIX B – NATIONAL OFFSHORE AQUACULTURE ACT OF 2007 SUMMARY AND H.R. 2010 IH APRIL 24, 2007 INTRODUCED BILL

The National Oceanic and Atmospheric Administration (NOAA), an agency within the U.S. Department of Commerce, is working to enhance/increase domestic seafood supply to meet the growing demand for all seafood products. Currently, over 80 percent of the seafood Americans consume is imported, and at least half of those imports are farmed seafood. Additional U.S. aquaculture can help the nation reduce its $8 billion seafood trade deficit, provide additional jobs and revenue for coastal communities, and meet the growing consumer demand for safe, healthy seafood.

Right now, most U.S. marine aquaculture products come from shellfish, which are grown onshore or in coastal areas. However, new technology and equipment, and the promising results of open ocean aquaculture demonstration projects in state waters, are leading to opportunities for seafood farming further from the coast, in federal waters three to 200 miles off shore. The federal waters of the U.S. Exclusive Economic Zone cover 3.4 million square miles of ocean and hold promise for this new type of aquaculture.

While there are many potential benefits to offshore aquaculture, there are also barriers blocking the expansion of aquaculture into federal waters. Currently, there is no clear authority for the permitting of offshore aquaculture in federal waters. To address this challenge, the Administration will propose the *National Offshore Aquaculture Act of 2007* early in the 110th Congress. If enacted, the Act will establish the legal framework regarding permits, enforcement, and monitoring of aquaculture in federal waters.
Specifically, the bill will:

- Authorize the Secretary of Commerce to issue offshore aquaculture permits.
- Require the Secretary of Commerce to establish environmental requirements.
- Require the Secretary of Commerce to work with other federal agencies to develop and implement a streamlined and coordinated permitting process for offshore aquaculture.
- Exempt permitted offshore aquaculture from fishing regulations that restrict size, season and harvest methods.
- Authorize the establishment of a research and development program for marine aquaculture.
- Authorize funding to carry out the Act and provide for enforcement of the Act.

The 2007 proposal includes requirements to ensure that offshore aquaculture proceeds in an environmentally responsible manner that is consistent with stated policy to protect wild stocks and the quality of marine ecosystems and is compatible with other uses of the marine environment. The intent of the Act is to complement rather than supersede

existing resource management authorities, so it specifically provides for coordination and consultation with other federal agencies, Fishery Management Councils, and coastal states.

In addition, the research and development provision of the act would authorize NOAA to fund the scientific research and the technology development necessary to help all types of domestic marine aquaculture to expand.

On a broad scale, the proposal will provide the necessary regulatory certainty to facilitate expansion of aquaculture in federal waters, where there is significant potential for development of the U.S. aquaculture industry. New technologies have been developed to better withstand extreme conditions of the offshore ocean environment, allowing this expansion to occur. By adopting these technologies, the United States can boost production of valuable marine species while creating jobs that contribute to economic development and the revitalization of depressed coastal communities. Additional domestic supplies of nutritious seafood can reduce pressure on wild fisheries. By adopting rigorous environmental standards for aquaculture, the United States can establish its leadership in development of sustainable uses of marine ecosystems, as an example for our trade partners, while leveling the playing field for U.S. fishery products.
Because of competing uses, community interest, and ocean conditions, offshore aquaculture will be better suited to some areas of the country than others. However, the most immediate challenge is to establish clear rules to allow this type of aquaculture and, ultimately, allow the nation to take advantage of this new opportunity for seafood production in federal waters. At the same time, the federal government must ensure that human health, the marine environment, and wild stocks are protected.

Source: www.noaa.gov/aquaculture

HR 2010 IH

110th CONGRESS
1st Session
H. R. 2010

To provide the necessary authority to the Secretary of Commerce for the establishment and implementation of a regulatory system for offshore aquaculture in the United States Exclusive Economic Zone, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES
April 24, 2007

Mr. RAHALL (for himself and Ms. BORDALLO) (both by request): introduced the following bill; which was referred to the Committee on Natural Resources, and in addition to the Committees on Ways and Means and Foreign Affairs, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned

A BILL

To provide the necessary authority to the Secretary of Commerce for the establishment and implementation of a regulatory system for offshore aquaculture in the United States Exclusive Economic Zone, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `National Offshore Aquaculture Act of 2007'.

SEC. 2. FINDINGS.

(a) It is the policy of the United States to:

(1) Support an offshore aquaculture industry that will produce food and other valuable products, protect wild stocks and the quality of marine ecosystems, and be compatible with other uses of the Exclusive Economic Zone;

(2) Encourage the development of environmentally responsible offshore aquaculture by authorizing offshore aquaculture operations and research;

(3) Establish a permitting process for offshore aquaculture that encourages private investment in aquaculture operations and research, provides opportunity for public comment, and addresses the potential risks to and impacts (including cumulative impacts) on marine ecosystems, human health and safety, other ocean uses, and coastal communities from offshore aquaculture;

(4) Promote, through public-private partnerships, research and development in marine aquaculture science, technology, and related social, economic, legal, and environmental management disciplines that will enable marine aquaculture operations to achieve operational objectives while protecting marine ecosystem quality.

(b) Offshore aquaculture activities within the Exclusive Economic Zone of the United States constitute activities with respect to which the United States has proclaimed sovereign rights and jurisdiction under Presidential Proclamation 5030 of March 10, 1983.

SEC. 3. DEFINITIONS.

As used in this Act--

(a) The term `coastal State' means a state of the United States in, or bordering on, the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, or Long Island Sound. The term also includes Puerto Rico, the Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, the Trust Territories of the Pacific Islands, and American Samoa.

(b) The term `coastline' means the line of ordinary low water along that portion of the coast that is in direct contact with the open sea and the line marking the seaward limit of inland waters.

(c) The term `Exclusive Economic Zone' means, unless otherwise specified by the President in the public interest in a writing published in the Federal Register, a zone, the outer boundary of which is 200 nautical miles from the baseline from which the breadth of the territorial sea is measured, except as established by a maritime boundary treaty in force, or being provisionally applied by the United States or, in the absence of such a treaty where the distance between the United States and another nation is less than 400 nautical miles, a line equidistant between the United States and the other nation. Without affecting any Presidential Proclamation with regard to the establishment of the United States territorial sea or Exclusive Economic Zone, the inner boundary of that zone is--

(1) a line coterminous with the seaward boundary of each of the several coastal States, as defined in 43 U.S.C. 1312;

(2) a line three marine leagues from the coastline of the Commonwealth of Puerto Rico;

(3) a line three geographical miles from the coastlines of American Samoa, the United States Virgin Islands, and Guam;

(4) for the Commonwealth of the Northern Mariana Islands--

(A) its coastline, until such time as the Commonwealth of the Northern Mariana Islands is granted authority by the United States to regulate all fishing to a line seaward of its coastline, and

(B) upon the United States' grant of such authority, the line established by such grant of authority; and

(5) for any possession of the United States not referred to in subparagraph (2), (3), or (4), the coastline of such possession.

Nothing in this definition shall be construed as diminishing the authority of the Department of Defense, the Department of the Interior or any other Federal department or agency.

(d) The term `lessee' means any party to a lease, right-of-use and easement, or right-of-way, or an approved assignment thereof, issued pursuant to the Outer Continental Shelf Lands Act, 43 U.S.C. 1331 et seq.

(e) The term `marine species' means finfish, mollusks, crustaceans, marine algae, and all other forms of marine life, excluding marine mammals and birds.
(f) The term `offshore aquaculture' means all activities, including the operation of offshore aquaculture facilities, involved in the propagation and rearing, or attempted propagation and rearing, of marine species in the United States Exclusive Economic Zone.
(g) The term `offshore aquaculture facility' means: 1) an installation or structure used, in whole or in part, for offshore aquaculture; or 2) an area of the seabed or the subsoil used for offshore aquaculture of living organisms belonging to sedentary species.
(h) The term `offshore aquaculture permit' means an authorization issued under section 4(b) to raise specified marine species in a specific offshore aquaculture facility within a specified area of the Exclusive Economic Zone.
(i) The term `person' means any individual (whether or not a citizen or national of the United States), any corporation, partnership, association, or other non-governmental entity (whether or not organized or existing under the laws of any State), and State, local or tribal government or entity thereof, and, except as otherwise specified by the President in writing, the Federal Government or an entity thereof, and, to the extent specified by the President in writing, a foreign government or an entity thereof.
(j) The term `Secretary' means the Secretary of Commerce.

SEC. 4. OFFSHORE AQUACULTURE PERMITS.

(a) General-

(1) The Secretary shall establish, through rulemaking, in consultation as appropriate with other relevant Federal agencies, coastal States, and regional fishery management councils established under section 302 of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1852), a process to make areas of the Exclusive Economic Zone available to eligible persons for the development and operation of offshore aquaculture facilities, which shall include:

(A) Procedures and criteria necessary to issue and modify permits under this Act;
(B) Procedures to coordinate the offshore aquaculture permitting process, and related siting, operations, environmental protection, monitoring, enforcement, research, and economic and social activities, with similar activities administered by other Federal agencies and coastal States;
(C) Consideration of the potential environmental, social, economic, and cultural impacts of offshore aquaculture and inclusion, where appropriate, of permit conditions to address negative impacts;
(D) Public notice and opportunity for public comment prior to issuance of offshore aquaculture permits;
(E) Procedures to monitor and evaluate compliance with the provisions of offshore aquaculture permits, including the collection

of biological, chemical and physical oceanographic data, and social, production, and economic data; and

(F) Procedures for transferring permits from the original permit holder to a person meeting the eligibility criteria in section 4(b)(2)(A) and able to satisfy the requirements for bonds or other guarantees prescribed under section 4(c)(3).

(2) The Secretary shall prepare an analysis under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) with respect to the process for issuing permits.

(3) The Secretary shall periodically review the procedures and criteria for issuance of offshore aquaculture permits and modify them as appropriate, in consultation as appropriate with other Federal agencies, the coastal States, and regional fishery management councils, based on the best available science.

(4) The Secretary shall consult as appropriate with other Federal agencies and coastal States to identify the environmental requirements that apply to offshore aquaculture under existing laws and regulations. The Secretary shall establish through rulemaking, in consultation with appropriate Federal agencies, coastal States, and regional fishery management councils established under section 302 of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1852), additional environmental requirements to address environmental risks and impacts associated with offshore aquaculture, to the extent necessary. The environmental requirements shall address, but are not limited to:

(A) risks to and impacts on natural fish stocks and fisheries, including safeguards needed to conserve genetic resources, to prevent or minimize the transmission of disease or parasites to wild stocks, and to prevent the escape of marine species that may cause significant environmental harm;

(B) risks to and impacts on marine ecosystems; biological, chemical and physical features of water quality and habitat; marine species, marine mammals and birds;

(C) cumulative effects of the aquaculture operation and other aquaculture operations in the vicinity of the proposed site;

(D) environmental monitoring, data archiving, and reporting by the permit holder;

(E) requirements that marine species propagated and reared through offshore aquaculture be species native to the geographic region unless a scientific risk analysis shows that the risk of harm to the marine environment from the offshore culture of non-indigenous or genetically modified marine species is negligible or can be effectively mitigated; and

(F) maintaining record systems to track inventory and movement of fish or other marine species in the offshore aquaculture facility or harvested from such facility, and, if necessary, tagging,

marking, or otherwise identifying fish or other marine species in the offshore aquaculture facility or harvested from such facility.

(5) The Secretary, in cooperation with other Federal agencies, shall:

(A) Collect information needed to evaluate the suitability of sites for offshore aquaculture; and

(B) Monitor the effects of offshore aquaculture on marine ecosystems and implement such measures as may be necessary to protect the environment. Measures may include, but are not limited to, temporary or permanent relocation of offshore aquaculture sites, a moratorium on additional sites within a prescribed area, and other appropriate measures as determined by the Secretary.

(b) Permits- Subject to the provisions of subsection (e), the Secretary may issue offshore aquaculture permits under such terms and conditions as the Secretary shall prescribe. Permits issued under this Act authorize the permit holder to conduct offshore aquaculture consistent with the provisions of this Act, regulations issued under this Act, any specific terms, conditions and restrictions applied to the permit by the Secretary, and other applicable law.

(1) PROCEDURES FOR ISSUANCE OF PERMITS-

(A) The applicant for an offshore aquaculture permit shall submit an application to the Secretary specifying the proposed location and type of operation, the marine species to be propagated or reared, or both, at the offshore aquaculture facility, and other design, construction, and operational information, as specified by regulation.

(B) Within 120 days after determining that a permit application is complete and has satisfied all applicable statutory and regulatory requirements, as specified by regulation, the Secretary shall issue or deny the permit. If the Secretary is unable to issue or deny a permit within this time period, the Secretary shall provide written notice to the applicant indicating the reasons for the delay and establishing a reasonable timeline for issuing or denying the permit.

(2) PERMIT CONDITIONS-

(A) An offshore aquaculture permit holder must (i) be a resident of the United States, (ii) be a corporation, partnership or other entity organized and existing under the laws of a State or the United States, or (iii) if neither (i) or (ii) applies, to the extent required by the Secretary by regulation after coordination with the Secretary of State, waive any immunity, and consent to the jurisdiction of the United States and its courts, for matters arising in relation to such permit, and appoint and maintain agents within the United States who are authorized to receive and respond to any legal process issued in the United States with respect to such permit holder.

(B) Subject to the provisions of subsection (e), the Secretary shall establish the terms, conditions, and restrictions that apply to

offshore aquaculture permits, and shall specify in the permits the duration, size, and location of the offshore aquaculture facility.

(C) Except for projects involving pilot-scale testing or farm-scale research on aquaculture science and technologies and offshore aquaculture permits requiring concurrence of the Secretary of the Interior under subsection 4(e)(1), the permit shall have a duration of 20 years, renewable thereafter at the discretion of the Secretary in up to 20-year increments. The duration of permits requiring concurrence of the Secretary of the Interior under subsection 4(e)(1) shall be developed in consultation as appropriate with the Secretary of the Interior, except that any such permit shall expire no later than the date that the lessee, or the lessee's operator, submits to the Secretary of the Interior a final application for the decommissioning and removal of an existing facility upon which an offshore aquaculture facility is located.

(D) At the expiration or termination of an offshore aquaculture permit for any reason, the permit holder shall remove all structures, gear, and other property from the site, and take other measures to restore the site as may be prescribed by the Secretary.

(E) Failure to begin offshore aquaculture operations within a reasonable period of time, or prolonged interruption of offshore aquaculture operations, may result in the revocation of the permit.

(3) If the Secretary determines that issuance of a permit is not in the national interest, the Secretary may decline to issue such a permit or may impose such conditions as necessary to address such concerns.

(c) Fees and Other Payments-

(1) The Secretary is authorized to establish, through regulations, application fees and annual permit fees. Such fees shall be deposited as offsetting collections in the Operations, Research, and Facilities (ORF) account. Fees may be collected and made available only to the extent provided in advance in appropriation Acts.

(2) The Secretary may reduce or waive applicable fees or other payments established under this section for facilities used primarily for research.

(3) The Secretary shall require the permit holder to post a bond or other form of financial guarantee, in an amount to be determined by the Secretary as sufficient to cover any unpaid fees, the cost of removing an offshore aquaculture facility at the expiration or termination of an offshore aquaculture permit, and other financial risks as identified by the Secretary.

(d) Compatibility With Other Uses-

(1) The Secretary shall consult as appropriate with other Federal agencies, coastal States, and regional fishery management councils to ensure that offshore aquaculture for which a permit is issued under this section is compatible with the use of the Exclusive Economic Zone for navigation, fishing, resource protection, recreation, national defense (including military readiness), mineral exploration and development, and other activities.

(2) The Secretary shall not authorize permits for new offshore aquaculture facilities within 12 miles of the coastline of a coastal State if that coastal State has submitted a written notice to the Secretary that the coastal State opposes such activities. This provision will not apply to permit applications received by the Secretary prior to the date the notice is received from a coastal State. A coastal State that transmitted such notice to the Secretary under this paragraph may revoke that notice in writing at any time.

(3) Federal agencies implementing this Act, persons subject to this Act, and coastal States seeking to review permit applications under this Act shall comply with the applicable section of the Coastal Zone Management Act (i.e., 16 U.S.C. 1456(c)(1), (c)(3)(A), (c)(3)(B) or (d)) and its corresponding Federal regulations.

(4) Offshore aquaculture conducted in accordance with permits issued pursuant to this Act is excluded from the definition of `fishing' in the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1802(15)). The Secretary shall ensure, to the extent practicable, that offshore aquaculture does not interfere with conservation and management measures promulgated under the Magnuson-Stevens Fishery Conservation and Management Act.

(5) The Secretary may promulgate regulations that the Secretary finds to be reasonable and necessary to protect offshore aquaculture facilities, and, where appropriate, shall request that the Secretary of the department in which the Coast Guard is operating establish navigational safety zones around such facilities. In addition, in the case of any offshore aquaculture facility described in section 4(e)(1), the Secretary of the department in which the Coast Guard is operating shall consult with the Secretary of the Interior before designating such a zone.

(6) After consultation with the Secretary, the Secretary of State, and the Secretary of Defense, the Secretary of the department in which the Coast Guard is operating may designate a zone of appropriate size around and including any offshore aquaculture facility for the purpose of navigational safety. In such a zone, no installations, structures, or uses will be allowed that are incompatible with the operation of the offshore aquaculture facility. The Secretary of the department in which the Coast Guard is operating may define, by rulemaking, activities that are allowed within such a zone.

(7)(A) Subject to paragraph (B), if the Secretary, after consultation with Federal agencies as appropriate and after affording the permit holder notice and an opportunity to be heard, determines that suspension, modification, or revocation of a permit is in the national interest, the Secretary may suspend, modify, or revoke such permit.

(B) If the Secretary determines that an emergency exists that poses a risk to the safety of humans, to the marine environment or marine species, or to the security of the United States and that requires suspension, modification, or

revocation of a permit, the Secretary may suspend, modify, or revoke the permit for such time as the Secretary may determine necessary to meet the emergency. The Secretary shall afford the permit holder a prompt post-suspension or post-modification opportunity to be heard regarding the suspension, modification, or revocation.

(8) Permits issued under this Act do not supersede or substitute for any other authorization required under applicable Federal or State law or regulation.

(e) Actions Affecting the Outer Continental Shelf-

(1) The Secretary shall obtain the concurrence of the Secretary of the Interior on permits for offshore aquaculture facilities located:

(A) on leases, right-of-use and easements, or rights of way authorized or permitted under the Outer Continental Shelf Lands Act, as amended (43 U.S.C. 1331, et seq.), or

(B) within 1 mile of any other facility permitted or for which a plan has been approved under the Outer Continental Shelf Lands Act.

(2) Offshore aquaculture may not be located on facilities subject to section 4(e)(1)(A) without the prior consent of the lessee, its designated operator, and owner of the facility.

(3) The Secretary of the Interior shall review and approve any agreement between a lessee, designated operator, and owner of a facility subject to this subsection and a prospective aquaculture operator to ensure that it is consistent with the Federal lease terms, Department of the Interior regulations, and the Secretary of the Interior's role in the protection of the marine environment, property, or human life or health. An agreement under this subsection shall be part of the information reviewed pursuant to the Coastal Zone Management Act review process described in subsection 4(e)(4) and shall not be subject to a separate Coastal Zone Management Act review.

(4) Coordinated Coastal Zone Management Act review

(A) If the applicant for an offshore aquaculture facility that will utilize a facility subject to this subsection is required to submit to a coastal State a consistency certification for its aquaculture application under section 307(c)(3)(A) of the Coastal Zone Management Act (16 U.S.C. 1456(c)(3)(A)), the coastal State's review under the Coastal Zone Management Act and corresponding Federal regulations shall also include any modification to a lessee's approved plan or other document for which a consistency certification would otherwise be required under applicable Federal regulations, including changes to its plan for decommissioning any facilities, resulting from or necessary for the issuance of the offshore aquaculture permit, provided that information related to such modifications or changes is received by the coastal State at the time the coastal State receives the offshore

aquaculture permit applicant's consistency certification. In this case, lessees are not required to submit a separate consistency certification for any such modification or change under section 307(c)(3)(B) of the Coastal Zone Management Act (16 U.S.C. 1456(c)(3)(B)) and the coastal State's concurrence or objection, or presumed concurrence, under section 307(c)(3)(A) of the Coastal Zone Management Act (16 U.S.C. 1456(c)(3)(A)) in a consistency determination for the offshore aquaculture permit, shall apply to both the offshore aquaculture permit and to any related modifications or changes to a lessee's plan approved under the Outer Continental Shelf Lands Act.

(B) If a coastal State is not authorized by section 307(c)(3)(A) of the Coastal Zone Management Act (16 U.S.C. 1456(c)(3)(A)) and corresponding Federal regulations to review an offshore aquaculture application submitted under this Act, then any modifications or changes to a lessee's approved plan or other document requiring approval from the Department of the Interior, shall be subject to coastal State review pursuant to the requirements of section 307(c)(3)(B) of the Coastal Zone Management Act (16 U.S.C. 1456(c)(3)(B)), if a consistency certification for those modifications or changes is required under applicable Federal regulations.

(5) For offshore aquaculture located on facilities subject to this subsection, the aquaculture permit holder and all parties that are or were lessees of the lease on which the facilities are located during the term of the offshore aquaculture permit shall be jointly and severally liable for the removal of any construction or modifications related to aquaculture operations if the aquaculture permit holder fails to do so and bonds established under this Act for aquaculture operations prove insufficient to cover those obligations. This subsection does not affect obligations to decommission facilities under the Outer Continental Shelf Lands Act.

(6) For aquaculture projects or operations subject to this subsection, the Secretary of the Interior is authorized to:

(A) Promulgate such rules and regulations as are necessary and appropriate to carry out the provisions of this subsection;

(B) Require and enforce such additional terms or conditions as the Secretary of the Interior deems necessary to protect the marine environment, property, or human life or health to ensure the compatibility of aquaculture operations with all activities for which permits have been issued under the Outer Continental Shelf Lands Act;

(C) Issue orders to the offshore aquaculture permit holder to take any action the Secretary of the Interior deems necessary to ensure safe operations on the facility to protect the marine environment, property, or human life or health. Failure to comply with the

Secretary of the Interior's orders will be deemed to constitute a violation of the Outer Continental Shelf Lands Act; and
(D) Enforce all requirements contained in such regulations, lease terms and conditions and orders pursuant to the Outer Continental Shelf Lands Act.

SEC. 5. RESEARCH AND DEVELOPMENT.

(a) In consultation as appropriate with other Federal agencies, the Secretary may establish and conduct an integrated, multidisciplinary, scientific research and development program to further marine aquaculture technologies that are compatible with the protection of marine ecosystems.
(b) The Secretary is authorized to conduct research and development in partnership with offshore aquaculture permit holders.
(c) The Secretary, in collaboration with the Secretary of Agriculture, shall conduct research to reduce the use of wild fish in aquaculture feeds, including but not limited to the substitution of seafood processing wastes, cultured marine algae and microbial sources of nutrients important for human health and nutrition, agricultural crops, and other products.

SEC. 6. ADMINISTRATION.

(a) The Secretary shall promulgate such regulations as are necessary and appropriate to carry out the provisions of this Act. The Secretary may at any time amend such regulations, and such regulations shall, as of their effective date, apply to all operations conducted pursuant to permits issued under the provisions of this Act, regardless of the date of the issuance of such permit.
(b) The Secretary shall have the authority to enter into and perform such contracts, leases, grants, or cooperative agreements as may be necessary to carry out the purposes of this Act and on such terms as the Administrator of the National Oceanic and Atmospheric Administration deems appropriate.
(c) For purposes related to the enforcement of this Act, the Secretary is authorized to use, with their consent and with or without reimbursement, the land, services, equipment, personnel, and facilities of any department, agency or instrumentality of the United States, or of any state, local government, Indian tribal government, Territory or possession, or of any political subdivision thereof, or of any foreign government or international organization.
(d) Authority to Utilize Grant Funds

(1) Except as provided in paragraph (2), the Secretary is authorized to apply for, accept, and obligate research grant funding from any Federal source operating competitive grant programs where such funding furthers the purpose of this Act.
(2) The Secretary may not apply for, accept, or obligate any grant funding under paragraph (1) for which the granting agency lacks authority to grant funds to Federal agencies, or for any purpose or subject to conditions that are prohibited by law or regulation.

(3) Appropriated funds may be used to satisfy a requirement to match grant funds with recipient agency funds, except that no grant may be accepted that requires a commitment in advance of appropriations.
(4) Funds received from grants shall be deposited in the National Oceanic and Atmospheric Administration account that serves to accomplish the purpose for which the grant was awarded.

(e) Nothing in this Act shall be construed to displace, supersede, or limit the jurisdiction, responsibilities or rights of any Federal or State agency, or Indian Tribe or Alaska Native organization, under any Federal law or treaty.

(f) The Constitution, laws, and treaties of the United States shall apply to an offshore aquaculture facility located in the Exclusive Economic Zone for which a permit has been issued or is required under this Act and to activities in the Exclusive Economic Zone connected, associated, or potentially interfering with the use or operation of such facility, in the same manner as if such facility were an area of exclusive Federal jurisdiction located within a State. Nothing in this Act shall be construed to relieve, exempt, or immunize any person from any other requirement imposed by an applicable Federal law, regulation, or treaty. Nothing in this Act shall be construed to confer citizenship to a person by birth or through naturalization or to entitle a person to avail himself of any law pertaining to immigration, naturalization, or nationality.

(g) The law of the nearest adjacent coastal State, now in effect or hereafter adopted, amended, or repealed, is declared to be the law of the United States, and shall apply to any offshore aquaculture facility for which a permit has been issued pursuant to this Act, to the extent applicable and not inconsistent with any provision or regulation under this Act or other Federal laws and regulations now in effect or hereafter adopted, amended, or repealed. All such applicable laws shall be administered and enforced by the appropriate officers and courts of the United States. For purposes of this subsection, the nearest adjacent coastal State shall be that State whose seaward boundaries, if extended beyond 3 nautical miles, would encompass the site of the offshore aquaculture facility. State taxation laws shall not apply to offshore aquaculture facilities in the Exclusive Economic Zone.

SEC. 7. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary $4,052,000 in fiscal year 2008 and thereafter such sums as may be necessary for purposes of carrying out the provisions of this Act.

SEC. 8. UNLAWFUL ACTIVITIES.

It is unlawful for any person--

(a) to falsify any information required to be reported, communicated, or recorded pursuant to this Act or any regulation or permit issued under this Act, or to fail to submit in a timely fashion any required information, or to fail to report to the Secretary immediately any change in circumstances that has the effect of rendering any such information false, incomplete, or misleading;

(b) to engage in offshore aquaculture within the Exclusive Economic Zone of the United States or operate an offshore aquaculture facility within the Exclusive Economic Zone of the United States, except pursuant to a valid permit issued under this Act;
(c) to refuse to permit an authorized officer to conduct any lawful search or lawful inspection in connection with the enforcement of this Act or any regulation or permit issued under this Act;
(d) to forcibly assault, resist, oppose, impede, intimidate, or interfere with an authorized officer in the conduct of any search or inspection in connection with the enforcement of this Act or any regulation or permit issued under this Act;
(e) to resist a lawful arrest or detention for any act prohibited by this section;
(f) to interfere with, delay, or prevent, by any means, the apprehension, arrest, or detection of another person, knowing that such person has committed any act prohibited by this section;
(g) to import, export, sell, receive, acquire or purchase in interstate or foreign commerce any marine species in violation of this Act or any regulation or permit issued under this Act;
(h) upon the expiration or termination of any aquaculture permit for any reason, fail to remove all structures, gear, and other property from the site, or take other measures, as prescribed by the Secretary, to restore the site;
(i) to violate any provision of this Act, any regulation promulgated under this Act, or any term or condition of any permit issued under this Act; or
(j) to attempt to commit any act described in subsections (a), (b), (g), (h) or (i).

SEC. 9. ENFORCEMENT PROVISIONS.

(a) Duties of Secretaries- Subject to sections 4(e)(6)(B) and (D), this Act shall be enforced by the Secretary and the Secretary of the department in which the Coast Guard is operating.

(b) Powers of Enforcement-

(1) Any officer who is authorized pursuant to subsection (a) of this section by the Secretary or the Secretary of the department in which the Coast Guard is operating to enforce the provisions of this Act may--

(A) with or without a warrant or other process--

(i) arrest any person, if the officer has reasonable cause to believe that such person has committed or is committing an act prohibited by section 8 of this Act;
(ii) search or inspect any offshore aquaculture facility and any related land-based facility;
(iii) seize any offshore aquaculture facility (together with its equipment, records, furniture, appurtenances, stores, and cargo), and any vessel or vehicle, used or employed in aid of, or with respect to which it reasonably appears that such offshore aquaculture facility was used or employed in aid of, the violation of any provision of this Act or any regulation or permit issued under this Act;

(iv) seize any marine species (wherever found) retained, in any manner, in connection with or as a result of the commission of any act prohibited by section 8 of this Act;
(v) seize any evidence related to any violation of any provision of this Act or any regulation or permit issued under this Act;

(B) execute any warrant or other process issued by any court of competent jurisdiction; and

(C) exercise any other lawful authority.

(2) Any officer who is authorized pursuant to subsection (a) of this section by the Secretary or the Secretary of the department in which the Coast Guard is operating to enforce the provisions of this Act may make an arrest without a warrant for (i) an offense against the United States committed in his presence, or (ii) for a felony cognizable under the laws of the United States, if he has reasonable grounds to believe that the person to be arrested has committed or is committing a felony. Any such authorized person may execute and serve a subpoena, arrest warrant or search warrant issued in accordance with Rule 41 of the Federal Rules of Criminal Procedure, or other warrant of civil or criminal process issued by any officer or court of competent jurisdiction for enforcement of the Act, or any regulation or permit issued under this Act.

(c) Issuance of Citations- If any authorized officer finds that a person is engaging in or has engaged in offshore aquaculture in violation of any provision of this Act, such officer may issue a citation to that person.

(d) Liability for Costs- Any person who violates this Act, or a regulation or permit issued under this Act, shall be liable for the cost incurred in storage, care, and maintenance of any marine species or other property seized in connection with the violation.

SEC. 10. CIVIL ENFORCEMENT AND PERMIT SANCTIONS.

(a) Civil Administrative Penalties-

(1) Any person who is found by the Secretary, after notice and opportunity for a hearing in accordance with section 554 of Title 5, United States Code, to have violated this Act, or a regulation or permit issued under this Act, shall be liable to the United States for a civil penalty. The amount of the civil penalty under this paragraph shall not exceed $200,000 for each violation. Each day of a continuing violation shall constitute a separate violation.

(2) COMPROMISE OR OTHER ACTION BY THE SECRETARY- The Secretary may compromise, modify, or remit, with or without conditions, any civil administrative penalty which is or may be imposed under this section and that has not been referred to the Attorney General for further enforcement action.

(b) Civil Judicial Penalties- Any person who violates any provision of this Act, or any regulation or permit issued thereunder, shall be subject to a civil penalty not to exceed $250,000 for each such violation. Each day of a continuing violation

shall constitute a separate violation. The Attorney General, upon the request of the Secretary, may commence a civil action in an appropriate district court of the United States, and such court shall have jurisdiction to award civil penalties and such other relief as justice may require. In determining the amount of a civil penalty, the court shall take into account the nature, circumstances, extent, and gravity of the prohibited acts committed and, with respect to the violator, the degree of culpability, any history of prior violations and such other matters as justice may require. In imposing such penalty, the district court may also consider information related to the ability of the violator to pay.

(c) Permit Sanctions-

(1) In any case in which--

(A) an offshore aquaculture facility has been used in the commission of an act prohibited under section 8 of this Act;

(B) the owner or operator of an offshore aquaculture facility or any other person who has been issued or has applied for a permit under section 4 of this Act has acted in violation of section 8 of this Act; or

(C) any amount in settlement of a civil forfeiture imposed on an offshore aquaculture facility or other property, or any civil penalty or criminal fine imposed under this Act or imposed on any other person who has been issued or has applied for a permit under any fishery resource statute enforced by the Secretary, has not been paid and is overdue, the Secretary may--

(i) revoke any permit issued with respect to such offshore aquaculture facility or applied for by such a person under this Act, with or without prejudice to the issuance of subsequent permits;

(ii) suspend such permit for a period of time considered by the Secretary to be appropriate;

(iii) deny such permit; or

(iv) impose additional conditions and restrictions on such permit.

(2) In imposing a sanction under this subsection, the Secretary shall take into account--

(A) the nature, circumstances, extent, and gravity of the prohibited acts for which the sanction is imposed; and

(B) with respect to the violator, the degree of culpability, any history of prior violations, and such other matters as justice may require.

(3) Transfer of ownership of an offshore aquaculture facility, by sale or otherwise, shall not extinguish any permit sanction that is in effect or is pending at the time of transfer of ownership. Before executing the transfer of ownership of an offshore aquaculture facility, by sale or otherwise, the owner shall disclose in writing to the prospective transferee the existence of any permit sanction that will be in effect or pending with respect to the offshore aquaculture facility at the time of the transfer. The Secretary may

waive or compromise a sanction in the case of a transfer pursuant to court order.

(4) In the case of any permit that is suspended under this subsection for nonpayment of a civil penalty or criminal fine, the Secretary shall reinstate the permit upon payment of the penalty or fine and interest thereon at the prevailing rate.

(5) No sanctions shall be imposed under this subsection unless there has been prior opportunity for a hearing on the facts underlying the violation for which the sanction is imposed, either in conjunction with a civil penalty proceeding under this section or otherwise.

(d) Injunctive Relief- Upon the request of the Secretary, the Attorney General of the United States is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation of any provision of this Act, or regulation or permit issued under this Act.

(e) Hearing- For the purposes of conducting any investigation or hearing under this section or any other statute administered by the National Oceanic and Atmospheric Administration which is determined on the record in accordance with the procedures provided for under section 554 of Title 5, the Secretary may issue subpoenas for the attendance and testimony of witnesses and the production of relevant papers, books, and documents, and may administer oaths. Witnesses summoned shall be paid the same fees and mileage that are paid to witnesses in the courts of the United States. In case of contempt or refusal to obey a subpoena served upon any person pursuant to this subsection, the district court of the United States for any district in which such person is found, resides, or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony before the Secretary or to appear and produce documents before the Secretary, or both, and any failure to obey such order of the court may be punished by such court as a contempt thereof. Nothing in this Act shall be construed to grant jurisdiction to a district court to entertain an application for an order to enforce a subpoena issued by the Secretary of Commerce to the Federal Government or any entity thereof.

(f) Jurisdiction- The United States district courts shall have original jurisdiction of any action under this section arising out of or in connection with the construction or operation of aquaculture facilities, and proceedings with respect to any such action may be instituted in the judicial district in which any defendant resides or may be found, or in the judicial district of the adjacent coastal State nearest the place where the cause of action arose. For the purpose of this section, American Samoa shall be included within the judicial district of the District Court of the United States for the District of Hawaii. Each violation shall be a separate offense and the offense shall be deemed to have been committed not only in the district where the violation first occurred, but also in any other district as authorized by law.

(g) Collection- If any person fails to pay an assessment of a civil penalty after it has become a final and unappealable order, or after the appropriate court has entered final judgment in favor of the Secretary, the matter may be referred to the

Attorney General, who may recover the amount (plus interest at currently prevailing rates from the date of the final order). In such action the validity, amount and appropriateness of the final order imposing the civil penalty shall not be subject to review. Any person who fails to pay, on a timely basis, the amount of an assessment of a civil penalty shall be required to pay, in addition to such amount and interest, attorney's fees and costs for collection proceedings and a quarterly nonpayment penalty for each quarter during which such failure to pay persists. Such nonpayment penalty shall be in an amount equal to 20 percent of the aggregate amount of such persons penalties and nonpayment penalties which are unpaid as of the beginning of such quarter.

(h) Nationwide Service of Process- In any action by the United States under this title, process may be served in any district where the defendant is found, resides, transacts business or has appointed an agent for the service of process, and for civil cases may also be served in a place not within the United States in accordance with Rule 4 of the Federal Rules of Civil Procedure.

SEC. 11. CRIMINAL OFFENSES.

(a) Any person (other than a foreign government or any entity of such government) who knowingly commits an act prohibited by subsections 8(c), (d), (e), or (f) of the Act, shall be imprisoned for not more than five years or shall be fined not more than $500,000 for individuals or $1,000,000 for an organization, or both; except that if in the commission of any such offense the individual uses a dangerous weapon, engages in conduct that causes bodily injury to any officer authorized to enforce the provisions of this title, or places any such officer in fear of imminent bodily injury, the maximum term of imprisonment is not more than ten years.

(b) Any person (other than a foreign government or any entity of such government) who knowingly violates any other provision of section 8, except subsections 8(c), (d), (e) or (f), of the Act, or any provision of any regulation promulgated pursuant to this title or any permit issued under this title, shall be imprisoned for not more than five years, or shall be fined not more than $500,000 for an individual or $1,000,000 for an organization, or both.

(c) The United States district courts shall have original jurisdiction of any action arising under this section out of or in connection with the construction or operation of aquaculture facilities, and proceedings with respect to any such action may be instituted in the judicial district in which any defendant resides or may be found. For the purpose of this section, American Samoa shall be included within the judicial district of the District Court of the United States for the District of Hawaii. Each violation shall be a separate offense and the offense shall be deemed to have been committed not only in the district where the violation first occurred, but also in any other district as authorized under law.

SEC. 12. FORFEITURES.

(a) Criminal Forfeiture- A person who is convicted of an offense in violation of section 11 of this Act shall forfeit to the United States--

(1) any property, real or personal, constituting or traceable to the gross proceeds obtained, or retained, as a result of the offense including, without limitation, any marine species (or the fair market value thereof) taken or retained in connection with or as a result of the offense; and

(2) any property, real or personal, used or intended to be used to commit or to facilitate the commission of the offense, including, without limitation, any offshore aquaculture facility or vessel, including its structure, equipment, furniture, appurtenances, stores, and cargo, and any vehicle or aircraft.

Pursuant to title 28, United States Code, section 2461(c), the provisions of section 413 of the Controlled Substances Act (21 U.S.C. 853) with the exception of subsection (d) of that section, shall apply to criminal forfeitures under this section.

(b) Civil Forfeiture- The following shall be subject to forfeiture to the United States and no property right shall exist in them:

(1) any property, real or personal, constituting or traceable to the gross proceeds obtained, or retained, as a result of a violation of any provision of section 8 or subsection 4(b)(2)(D) of this Act, including, without limitation, any marine species (or the fair market value thereof) taken or retained in connection with or as a result of the violation; and

(2) any property, real or personal, used or intended to be used to commit or to facilitate the commission of any such violation, including, without limitation, any offshore aquaculture facility or vessel, including its structure, equipment, furniture, appurtenances, stores, and cargo, and any vehicle or aircraft.

Civil forfeitures under this section shall be governed by the procedures set forth in title 18, United States Code, Chapter 46.

(c) Rebuttable Presumption- In any criminal or civil forfeiture proceeding under this section, there is a rebuttable presumption that all marine species found within an offshore aquaculture facility and seized in connection with a violation of section 8 of this Act were taken or retained in violation of this Act.

SEC. 13. SEVERABILITY AND JUDICIAL REVIEW.

(a) Severability- If any provision of this chapter or the application thereof to any person or circumstances is held invalid, the validity of the remainder of this chapter and of the application of such provision to other persons and circumstances shall not be affected thereby.

(b) Judicial Review-

(1) IN GENERAL- Judicial review of any action taken by the Secretary under this chapter shall be in accordance with sections 701 through 706 of Title 5, except that--

(A) review of any final agency action of the Secretary taken pursuant to section 11(a) or (c) of this title may be had only by the filing of a complaint by an interested person in the United States District Court for the appropriate district; any such complaint must be filed within 30 days of the date such final agency action is taken; and

(B) review of all other final agency actions of the Secretary under this chapter may be had only by the filing of a petition for review by an interested person in the Circuit Court of Appeals of the United States for the Federal judicial district in which such person resides or transacts business which is directly affected by the action taken; such petition shall be filed within 120 days from the date such final action is taken.

(2) LIMITATION OF JUDICIAL REVIEW- Final agency action with respect to which review could have been obtained under paragraph (1)(B) of this subsection shall not be subject to judicial review in any civil or criminal proceeding for enforcement.

(3) AWARDS OF LITIGATION COSTS- In any judicial proceeding under paragraph (1) of this subsection, the court may award costs of litigation (including reasonable attorney and expert witness fees) to any prevailing party whenever it determines that such award is appropriate.

END

APPENDIX C - GULF COUNCIL'S MARINE AQUACULTURE POLICY

The Gulf of Mexico Fishery Management Council (Council) defines marine aquaculture as the cultivation of marine plants or animals for food or other purposes. Recognizing that marine aquaculture presents both potential benefits as well as potential negative impacts, it is the policy of the Council to encourage environmentally responsible marine aquaculture; the Council encourages consideration of the following guidelines:

a. Cultured Species:

The Council recommends that genetic stocks native to the Gulf of Mexico and the geographic area in which they would be cultured receive priority as candidate culture species. Non-native species should be used only after thorough investigation has demonstrated no detrimental impacts on native species. The Council opposes use of non-native species in marine aquaculture systems unless demonstrated there would be no detrimental impacts on native species. The Council particularly opposes use of non-native species in open water environments where escapement can occur. The Council opposes the collection of juvenile native species for grow out.

Collection of native wild brood stock should be regulated in order to prevent overfishing cultured species stocks, and provision should be made to aid enforceability of possession, landing, and marketing of fish that would be illegal if wild caught fish.

Strategies should be adopted to minimize the potential that the genetic fitness (including both genetic variation and genetic composition) of wild populations would be diminished by marine aquaculture activities and escapement from marine aquaculture activities.

An invoice should accompany all cultured species through each sales transaction, including transactions at the place of the final sale to the consumer to verify the origin of the cultured species.

b. Habitat:

To ensure that marine aquaculture activities are environmentally responsible, the following considerations should be made with respect to habitat in that:

(1) Existing inland and offshore habitats important to marine fisheries should be protected from physical alterations or degradation;

(2) A baseline assessment should be conducted as part of the permitting process; and

(3) Sensitive areas, including habitat areas of particular concern, should be avoided.

c. Research:

The Council recommends the marine aquaculture industry demonstrate, in part, its stewardship of Gulf waters by:

(1). Actively educating its member institutions about necessary regulations and permits;

(2). Actively participating in research and monitoring to improve the understanding of marine aquaculture's relationship to coastal and marine ecosystems; and

(3). Participating in cooperative research to enhance knowledge of cultured species.

d. Location, Design, and Operation:

Marine aquaculture operations should be located, designed, operated, and monitored to prevent adverse impacts to estuaries, marine habitats and native fishery stocks. Impacts that cannot be prevented must be fully mitigated in-kind.

Conditions should be maintained to sustain healthy, diverse, native biological communities without the production of nuisance, toxic, or oxygen-demanding conditions.

Standard operating procedures should contain methods to prevent escapement, accidental transport, or release of cultured organisms.

Marine aquaculture operations should be conducted in accordance with a management plan that incorporates a routine monitoring program. The plan should be approved prior to the beginning of operations as part of the permitting process and modified as needed in accordance with adaptive management principles and based on the results of the monitoring program.

Marine aquaculture operations should develop an "emergency plan" that covers natural disasters such as tropical stouiis, floods, and hurricanes.

Ingress and egress of native wild organisms in natural and public waters should not be impeded by physical or water quality barriers.

Marine aquaculture operations in the EEZ should minimize disruption of navigation in natural or public waters.

Marine aquaculture facility locations should avoid areas of high commercial and recreational fishing activities.

Marine aquaculture facilities should avoid or at least minimize conflicts with or restrictions on recreational, for-hire, or commercial fishing activities.

When designing land-based marine aquaculture facilities, settling ponds, man-made wetlands, or other appropriate technologies should be used to allow for suspended solids

to settle out, allow the nutrient load to dissipate, and reduce overall discharge velocities prior to being discharged into the receiving water body.

As part of the permit process, measures should be established to deal with intentional or unintentional facility or property abandonment or other environmental liability to ensure that sites can be reclaimed without public expense and with minimal risk of long-term impact.

As part of the permitting process procedures should be established to deal with: removal of damaged equipment from the permitted site; recovery of equipment that may be unintentionally transported from the permitted site; and restoration of habitats that may be damaged by marine aquaculture activities, whether at the permitted site or elsewhere.

Mechanisms should be developed to ensure that marine aquaculture facilities and operations avoid harmful effects to both wild aquatic and terrestrial organisms.

e. Water Quality:

Marine aquaculture facilities should be designed, maintained, and operated in such a manner that avoids impacts to the local environment by utilizing water conservation practices and discharging effluent that protects existing designated use of receiving water and meets applicable state and federal water quality guidelines.

Marine aquaculture facilities should develop, implement, and monitor best management practices to conserve water and improve effluent water quality.

Comprehensive marine aquaculture facility waste management practices should be required to minimize negative impacts of discharge from the facility.

f. Health Management and Disease Control:

Marine aquaculture activities should:

1. Minimize impacts of disease outbreaks if they occur;

2. Create and implement health evaluation programs and policies that prevent the importation or release of disease pathogens or parasites of regulatory concern. These policies should support development and utilization of technologies to identify and control disease organisms;

3. Develop effective disease control, quarantine, and inventory destruction procedures to prevent the spread of disease to public waterways, native species, and other marine aquaculture facilities;

4. Create and implement health management strategies for marine aquaculture organisms in cooperation with states, federal agencies, industry, veterinarians, and scientists; and

5. Use only FDA approved therapeutic and chemical treatments as part of best management practices.

APPENDIX D – ALTERNATIVES CONSIDERED DURING THE SCOPING PROCESS, BUT REJECTED FROM DETAILED STUDY IN THE AMENDMENT

1. Require all permit applicants to indicate the actions they will take to comply with the provisions of the Council's Marine Aquaculture Policy that are applicable to offshore aquaculture.

Discussion: Actions and preferred alternatives considered in this amendment are consistent with the Council's Marine Aquaculture Policy. Permittees will be required to abide by numerous requirements outlined in the Council's Aquaculture Policy, including: using species native to the Gulf of Mexico, minimizing impacts of disease outbreaks, conducting routine monitoring, appropriately siting facilities, and protecting important habitat. In addition, Action 3 includes additional plans permittees must submit to NOAA Fisheries Service in order to ensure animal health is appropriately managed, genetic impacts on wild stocks are limited, environmental impacts are monitored, plans are in place for emergencies, and practices for collecting and spawning of broodstock.

2. Require permits for both persons (or firms) spawning brood stock and those raising fingerlings or juveniles in the EEZ.

Discussion: Action 1 discusses the types of permits that would be required for conducting aquaculture in the EEZ. The Council's preferred alternative would only require an operating permit, while Alternative 3 (Action 1) would require both an operating and a siting permit. The permit for operating a facility in the EEZ would encompass facilities that spawn brood stock and raise fingerlings or juveniles at facilities in the EEZ. Additionally, conditions specified in Action 3 require aquaculture operations to provide a description of the culture facility, if spawning and rearing activities will occur at a location other than the culture facility, and a list of names and addresses for spawning and rearing facilities used to obtain fingerlings and any relevant aquaculture permit numbers.

3. Permits should be issued 3 years or 7 years.

Discussion: Action 2 discusses the various permit durations considered by the Council. These range from 1 year (EFP) to an indefinite time period. The Council also considered permit durations of 5, 10 and 20 years. Permit durations of 3 and 7 years are within the range of possible permit durations considered within this amendment.

4. All fish landed or harvested from the facility should be reported quarterly to NMFS (by species and pounds) or the permit will not be renewed.

Discussion: Action 8, Alternative 2(b) requires aquaculture permittees to report all fish landed or harvested from a facility to NOAA Fisheries Service on a standardized annual report (Action 8, Alternative 2(j)), rather than reported quarterly. In addition, Action 3, Alternative 3(e)(vi) requires Law Enforcement be notified prior to harvest and transport

of cultured fish. Requiring quarterly reports was deemed unnecessary since most fish species will require greater than three months to grow to marketable sizes.

5. Require a program approved by NMFS and EPA to monitor the dissolved oxygen, carbon dioxide, ammonia and other water quality parameters around the marine aquaculture facility.

Discussion: Water quality standards and monitoring requirements are required by the EPA and NOAA Fisheries Service does not have the authority to require water quality monitoring for aquaculture facilities. Action 8, Alternative 2(a) requires permittees to provide NOAA Fisheries Service with copies of EPA permits. Action 3, Alternative 3(b)(iv) requires permittees to submit an environmental monitoring plan that discusses how they will comply with EPA standards. Standards and monitoring requirements will be specified in the NPDES permit issued by the EPA, in consultation with NOAA Fisheries Service and other state and federal agencies.

6. Require each permittee to specify their operational plans for dealing with hurricanes, vessel collision, fire, and structure damage.

Discussion: Action 3, Alternative 3(b)(v) requires permittees to describe emergency disaster plans for hurricanes, net or cage failure/escapement, and pollution events. Plans for vessel collision and fire are not required, but could be provided as part of a facilities disaster plans.

7. Prohibit the use of species that are threatened, endangered, candidates for threatened species or species for which wild harvest is prohibited.

Discussion: The Council believed allowing the harvest of threatened and endangered species was prudent and could partly assist in the rebuilding of these depleted stocks if they were cultured and subsequently released as part of intentional stock enhancement projects that may be carried out by state agencies, research centers, or other entities interested in the recovery of those stocks.

8. Fingerlings must be inspected by a certified fish health specialist and determined to be disease-free prior to stocking in a marine aquaculture facility.

Discussion: Action 3, Alternative 3(b)(ii) requires permittees to describe plans for aquatic animal health management, including procedures for prestocking inspections of aquatic animals and identification of an aquatic animal health specialists. It will be in the best interest of the operation to stock disease-free animals since profits will be dependent on the survival of fish to marketable sizes. As part of the animal health management plan it is expected procedures for inspecting species prior to stocking will be described.

9. Only medicinal therapeutics approved by FDA may be used.

Discussion: The FDA has the authority to approve the use of medicinal therapeutics. Regardless of whether the Council specifies FDA therapeutics must be used for aquaculture, aquaculture operations would be required to abide by FDA regulations.

10. Quarterly reports will be filed with NMFS on:

- **substrate and water quality monitoring;**
- **disease outbreak;**
- **any use of medicinal therapeutics;**
- **summaries of events related to escapement of fish, damage to cages or pens and marine mammal and endangered species interaction during that quarter.**

Discussion: Action 8 requires instances of any disease or parasites impacting greater than 10 percent of the swimming stock must be reported to NOAA Fisheries Service immediately after diagnosis with percent of swimming stock infected; a plan of action for managing the disease outbreak with treatment and consultations with marine fish disease specialists. Also, escapement events, damage to cages and pens, and interactions with marine mammals and endangered species needs to be reported immediately to NOAA Fisheries Service. For all other reporting requirements an annual standardized report will be required for each aquaculture facility. This report will address activities outlined in Action 8, including disease outbreaks, fish escapement, and entanglements. Requiring an annual, rather than quarterly report, was deemed more appropriate since the amount of time to raise most cultured species to marketable size is greater than three months. Additionally, facilities will be required to abide by FDA regulations when using medicinal therapeutics and EPA standards for pollution discharge and monitoring. These requirements fall outside the authority of NOAA Fisheries Service.

11. Describe plans for one or more of the following:

- **physical maintenance of the facility;**
- **preventing localized biological oxygen demand (BOD)**
- **localized hypoxic conditions.**

Discussion: The EPA establishes standards for water pollution discharge and monitoring. Requiring plans for preventing BOD and localized hypoxic conditions is outside the authority of NOAA Fisheries Service. However, Action 3, Alternative 3(b)(iv) requires permittees to describe plans for complying with EPA environmental monitoring standards. Standards and monitoring requirements will be specified in the NPDES permit issued by the EPA, in consultation with NOAA Fisheries Service and other state and federal agencies.

Physical maintenance of facilities is considered a normal business practice. Proper maintenance will potentially increase productivity of a facility and minimize the risk of system failure and fish escapement. Requiring a plan for physically maintaining a facility was deemed unnecessary. However, if cages and pens associated with a facility fail, Action 8 requires an immediate report be sent to NOAA Fisheries Service, and Action 3 requires a plan of action for any such event.

12. Allow the aquaculture of all marine species native to the Gulf of Mexico, except highly migratory species.

Discussion: The Council believed it was important to include highly migratory species for use in aquaculture. Although the Council does not have the authority to regulate highly migratory species, Action 4, Alternative 4 states that the Council will send a letter to NOAA Fisheries Service requesting development of concurrent rulemaking to allow aquaculture of highly migratory species.

13. Allow the aquaculture of all marine species managed by the Council.

Discussion: The Council concluded that shrimp would not be cultured in the EEZ since they are normally raised in coastal ponds in jurisdiction of the states, e.g., about 1 million pounds are raised annually in Texas waters. The regional fishery management councils in the Southeast all prohibit harvest of corals except for scientific purposes. Allowance for aquaculture would increase the likelihood that coral will be illegally harvested for the aquarium trade.

APPENDIX E – EXPLANATION OF ECONOMIC TERMS

Cointegrated variables: These are pairs of nonstationary variables that wander in such a way that they do not drift too far apart because they share a common trend. Examples are imports and exports, prices and wages, spot and future prices, and the price of cod and prices of other groundfish species. The common trend may cause strong multicollinearity, which may motivate a researcher to ignore one of the variables despite the loss of useful information. Nonstationary variables are variables that do not have a fixed mean and constant variance.

Cointegration analysis: A statistical analysis used to test for and estimate the co-movement of cointegrated variables. This co-movement is interpreted as a long-run equilibrium relationship.

Common property: Property that is owned by two or more individuals. Every member of the group that owns the property has equal right of ownership and can exclude non-members from use or consumption of that property.

Compensation principle: The amount that those who gain from a change could pay those who lose to fully compensate them for their losses.

Complementary goods: Goods (commodities) that are used together, like coffee and cream. A positive cross-price flexibility means the two goods are complementary goods; a percentage increase in the supply of coffee causes a percentage increase in the price of cream. Similarly, a negative cross-price elasticity of demand means the two goods are complementary goods; a percentage decrease in the price of coffee causes a percentage increase in the quantity demanded of cream.

Constant returns to scale: Output changes in the same proportion as inputs. For example, when a firm doubles inputs and, in so doing, doubles output, there are constant returns to scale.

Consumer surplus: The difference between the maximum a person (consumer) is willing and able to pay for a good (commodity) and the amount the person actually pays to acquire that good. It also represents the difference between the maximum amount that persons (consumers) are willing and able to pay for a good and the amount they actually pay to acquire that good.

Cross price elasticity of demand: The sensitivity of a change in the quantity demanded for a good (commodity) to a change in the price of another good. It is expressed as the percentage change in the quantity demanded for a good caused by a percentage change in the price of another good.

Cross-price flexibility: The sensitivity of a change in the price of a commodity for a change in the supply of another commodity. It is expressed as the percentage change in

the price of a commodity caused by a percentage change in the supply of another commodity.

Decreasing returns to scale: Output changes in a smaller proportion than inputs. For example, when a firm doubles inputs and, in so doing, output less than doubles, there are decreasing returns to scale.

Differentiated products: Products that are similar, but not identical, and satisfy the same need.

Economic efficiency: Economic efficiency is achieved when the cost of producing a particular level of output is as low as possible.

Economic profit: A firm's total revenue less its total explicit and implicit costs.

Economic rent: The difference between what a resource is paid for its use in production and the payment that was necessary to bring that resource into production.

Explicit costs: Explicit costs are accounting costs, such as wages, bait, diesel fuel, and depreciation of a fishing vessel.

External benefits: Beneficial side effects borne by those not directly involved in the production or consumption of a commodity.

External costs: Harmful side effects borne by those not directly involved in the production or consumption of a commodity.

Externality: An unintended cost or benefit that is imposed on people and that results from the economic activity of another. An unintended cost is called a negative externality, while an unintended benefit is called a positive externality.

Goods: Commodities of which more is preferred to less.

Implicit costs: Implicit costs are related to foregone benefits and are often referred to as opportunity costs. For example, an implicit cost of using a vessel to target a particular species is the revenue that could have been earned by targeting a different species.

Increasing returns to scale: Output changes at a larger portion than inputs. For example, when a firm doubles inputs and, in so doing, more than doubles output, there are increasing returns to scale.

Inputs: Factors of production or resources that are used to produce goods and services. Examples of inputs are labor, cages, and fish feed.

Internal or private costs: The costs imposed by an entity on itself.

Internal or private benefits: The benefits that an entity bestows upon itself.

Long run: The duration of time in which all inputs can be varied.

Market failure: The inability of a market to allocate resources efficiently. The market is unable to maximize social net benefits. Social costs may be greater than private costs.

Net National Benefits: Without externalities, it is the sum of consumer surplus plus producer surplus, which is a measure of the aggregate net benefits to both consumers and producers. However, with externalities, it is the sum of consumer surplus plus producer surplus plus third-party surplus.

Opportunity cost: The opportunity cost of supplying a production input, such as one's labor, for a particular use is the lost benefit of supplying that input to the next best alternative.

Own-price elasticity of demand: The sensitivity of a change in the quantity demanded for a good (commodity) to a change in the price of that good. It is expressed as the percentage change in the quantity demanded for a good caused by a percentage change in the price of that good.

Price elasticity of demand: The sensitivity of a change in the quantity demanded for a good (commodity) to a change in the price. It is expressed as the percentage change in the quantity demanded for a good caused by a percentage change in the price.

Price elasticity of supply: The sensitivity of a change in the quantity supplied of a good for a change in price. It is expressed as the percentage change in the quantity supplied caused by a percentage change in the price.

Price flexibility: The sensitivity of a change in the price of a commodity for a change in supply. It is expressed as the percentage change in the price of a commodity caused by a percentage change in supply.

Private benefits: See internal benefits.

Private costs: See internal costs.

Private good: A good or service for which consumption by one or more individuals excludes others from consuming that same good and reduces the amount available for others to consume.

Private property: Property owned by an individual who has the right to exclude others from using it. In law, private property is defined as property protected from public appropriation – over which the owner has exclusive and absolute rights.

Producer surplus: The difference between the price that a producer actually receives and the minimum price that the producer would have to receive to supply a given level of output. It also represents the difference between the price that producers receive for selling a given level of output and the minimum amount that they would have to receive to supply that level of output.

Property: A resource, good or service that can be used or consumed. In law, property is defined as the right to possess, use, and enjoy a determinate thing.

Property right: A bundle of rules that convey certain powers to the owner of the right. A property right has *exclusivity* if the owner can prevent others from using the property. It has *flexibility* if the owner can change the mode or purpose of using the resource. It has *divisibility* if the owner can subdivide the property. It has *transferability* if the owner can sell or give others all or a portion of the property. It has *durability* (or duration) if the owner permanently owns the property; and it has *enforceability* when the owner's property right is protected by government.

Public good: A commodity or service for which consumption by some individuals neither: 1) excludes others from consuming that good or service, nor 2) reduces the amount available for others to consume. Climate is an example of a public good.

Public property: Property that is owned by a local, state or federal government, and whose use cannot be restricted to any one individual.

Public trust doctrine: This is the principle that the government must preserve certain resources, such as navigable waters, for public use and maintain those resources for the public's use.

Pure property right: A bundle of rules that grant the owner of the property the exclusive authority to determine how a resource is used and

Quasi-property rights: Quasi-property rights are limited property rights, such as Individual Transfer Quotas (ITQs) and enterprise allocations. In law, quasi is defined as seemingly but not actually; in some sense; resembling; nearly.

Risk: When there is risk, one's choice of action does not determine the outcome with certainty. Instead there is a set of random possible outcomes. In other words, risk is the possibility of different outcomes occurring when the probability of different outcomes is known.

Short run: The duration of time in which the quantity of at least one input cannot be varied.

Social benefits: The sum of internal benefits and external benefits. These are the benefits borne by society as a whole.

Social costs: The sum of internal costs plus external costs. These are the costs incurred by society as a whole.

Social welfare function: A hypothetical relationship that weighs each individual's well-being or utility in some fashion, then adds up the utilities to obtain an aggregate (social welfare) function that is used to compare alternative equilibria.

Social welfare optimization: It is assumed that the social optimum or social welfare maximization is the equilibrium price and output level that maximizes the sum of consumer surplus plus producer surplus.

Strong cross-price flexibility: Occurs when a one percentage change in the supply of a commodity causes a large percentage change in the price of another commodity.

Strong property rights: Property rights that rank high in exclusivity, flexibility, divisibility, transferability, durability, and enforceability. See property rights for definitions of these terms.

Substitute goods: Goods (commodities) that replace each other, such as farmed raised shrimp and wild shrimp. A negative cross-price flexibility means the two goods are substitute goods; a percentage increase in the supply of farmed raised shrimp causes a percentage decrease in the price of wild shrimp. Similarly, a positive cross-price elasticity of demand means the two goods are substitutes; a percentage decrease in the price of farmed shrimp causes a percentage decrease in the quantity demanded of wild shrimp.

Third party: A person whom is unintentionally affected by an externality produced by the economic activity of another. For example, a person that owns a house on a river is a third party when the value of that person's house is affected by the pollution produced by a firm upstream.

Third-party surplus: Surplus that is experienced by a third party (or third parties), which is created by positive and negative externalities and therefore not captured in the market.

Total domestic surplus: The sum of consumer surplus of domestic consumers and producer surplus of domestic firms. It is the surplus that occurs when the level of domestic production of a good or service exceeds the level of domestic consumption of that good or service.

Total surplus: The sum of consumer surplus plus producer surplus plus third-party surplus.

Technical efficiency: Technical efficiency is achieved when the amount produced with a particular combination of inputs is the maximum amount that can be produced with that combination of inputs.

Utility: The ability of a good or service to satisfy a want.

Utility function: A hypothetical mathematical relationship that expresses the levels of satisfaction that a person receives from consuming combinations of goods and services, including leisure time.

Weak cross-price flexibility: Occurs when a one percentage change in the supply of a commodity causes a small percentage change in the price of another commodity.

Weak property rights: Property rights that rank low in exclusivity, flexibility, divisibility, transferability, durability, and enforceability. See property rights for definitions of these terms.

APPENDIX F - STOCKS MANAGED IN COUNCIL FMPs

Reef Fish FMP

Species in the Management Unit

Snappers - Lutjanidae Family

Queen Snapper	*Etelis oculatus*
Mutton Snapper	*Lutjanus analis*
Schoolmaster	*Lutjanus apodus*
Blackfin Snapper	*Lutjanus buccanella*
Red Snapper	*Lutjanus campechanus*
Cubera Snapper	*Lutjanus cyanopterus*
Gray (Mangrove) Snapper	*Lutjanus griseus*
Dog Snapper	*Lutjanus jocu*
Mahogany Snapper	*Lutjanus mahogoni*
Lane Snapper	*Lutjanus synagris*
Silk Snapper	*Lutjanus vivanus*
Yellowtail Snapper	*Ocyurus chrysurus*
Wenchman	*Pristipomoides aquilonaris*
Vermilion Snapper	*Rhomboplites aurorubens*

Groupers - Serranidae Family

Rock Hind	*Epinephelus adscensionis*
Speckled Hind	*Epinephelus drummondhayi*
Yellowedge Grouper	*Epinephelus flavolimbatus*
Red Hind	*Epinephelus guttatus*
Goliath Grouper	*Epinephelus itajara*
Red Grouper	*Epinephelus morio*
Misty Grouper	*Epinephelus mystacinus*
Warsaw Grouper	*Epinephelus nigritus*
Snowy Grouper	*Epinephelus niveatus*
Nassau Grouper	*Epinephelus striatus*
Black Grouper	*Mycteroperca bonaci*
Yellowmouth Grouper	*Mycteroperca interstitialis*
Gag	*Mycteroperca microlepis*
Scamp	*Mycteroperca phenax*
Yellowfin Grouper	*Mycteroperca venenosa*

Tilefishes - Malacanthidae (Branchiostegidae) Family

Goldface Tilefish	*Caulolatilus crysops*
Blackline Tilefish	*Caulolatilus cyanops*
Anchor Tilefish	*Caulolatilus intermedius*
Blueline Tilefish	*Caulolatilus microps*
Tilefish	*Lopholatilus chamaeleonticeps*

Jacks - Carangidae Family

Greater Amberjack	*Seriola dumerili*
Lesser Amberjack	*Seriola fasciata*
Almaco Jack	*Seriola rivoliana*
Banded Rudderfish	*Seriola zonata*

Triggerfishes - Balistidae Family

Gray Triggerfish	*Balistes capriscus*

Wrasses - Labridae Family

Hogfish	*Lachnolaimus maximus*

Species in the Management Unit for Data Collection Only

Sand Perches - Serranidae Family

Dwarf Sand Perch	*Diplectrum bivattatum*
Sand Perch	*Diplectrum formosum*

Red Drum FMP

Species in the Management Unit

red drum	*Sciaenops ocellatus*

Coastal Migratory Pelagics FMP

Species in the Management Unit

King Mackerel	*Scomberomorus cavalla*
Spanish Mackerel	*Scomberomorus maculatus*
Cobia	*Rachycentron canadum*

Species in the Management Unit for Data Collection Only

Cero	*Scomberomorus regalis*
Little Tunny	*Euthynnus alletteratus*
Dolphin	*Coryphaena hippurus*
Bluefish	*Pomatomus saltatrix*

Species that may be added to the Management Unit

Wahoo	*Acanthocybium solandri*
Blackfin tuna	*Thunnus atlanticus*
Blue runner	*Caranx crysos*

Shrimp FMP

Species in the Management Unit

Brown Shrimp	*Farfontepenaeus aztecus*
White Shrimp	*Litopenaeus setiferus*
Pink Shrimp	*Farfontepenaeus duorarum*

Royal Red Shrimp *Hymenopenaeus robustus*

Spiny Lobster FMP

Species in the Management Unit

Spiny Lobster	*Panulirus argus*
Slipper Lobster	*Scyllarides nodifer*

Species in the Management Unit for Data Collection Only

Spotted Spiny Lobster	*Panulirus argus*
Smooth Tail Lobster	*Panulirus laevicauda*
Spanish Slipper Lobster	*Scyllarides aequinoctialis*

Stone Crab FMP

Species in the Management Unit

Stone Crab	*Menippe mercenaria*
Stone Crab (Cedar Key north)	*Menippe adina*

Coral FMP

Species in the Management Unit (330)

Corals of the Class *Hydrozoa*

Corals of the Class *Anthozoa*

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APPENDIX G - ILLUSTRATIONS OF CAGES AND PENS

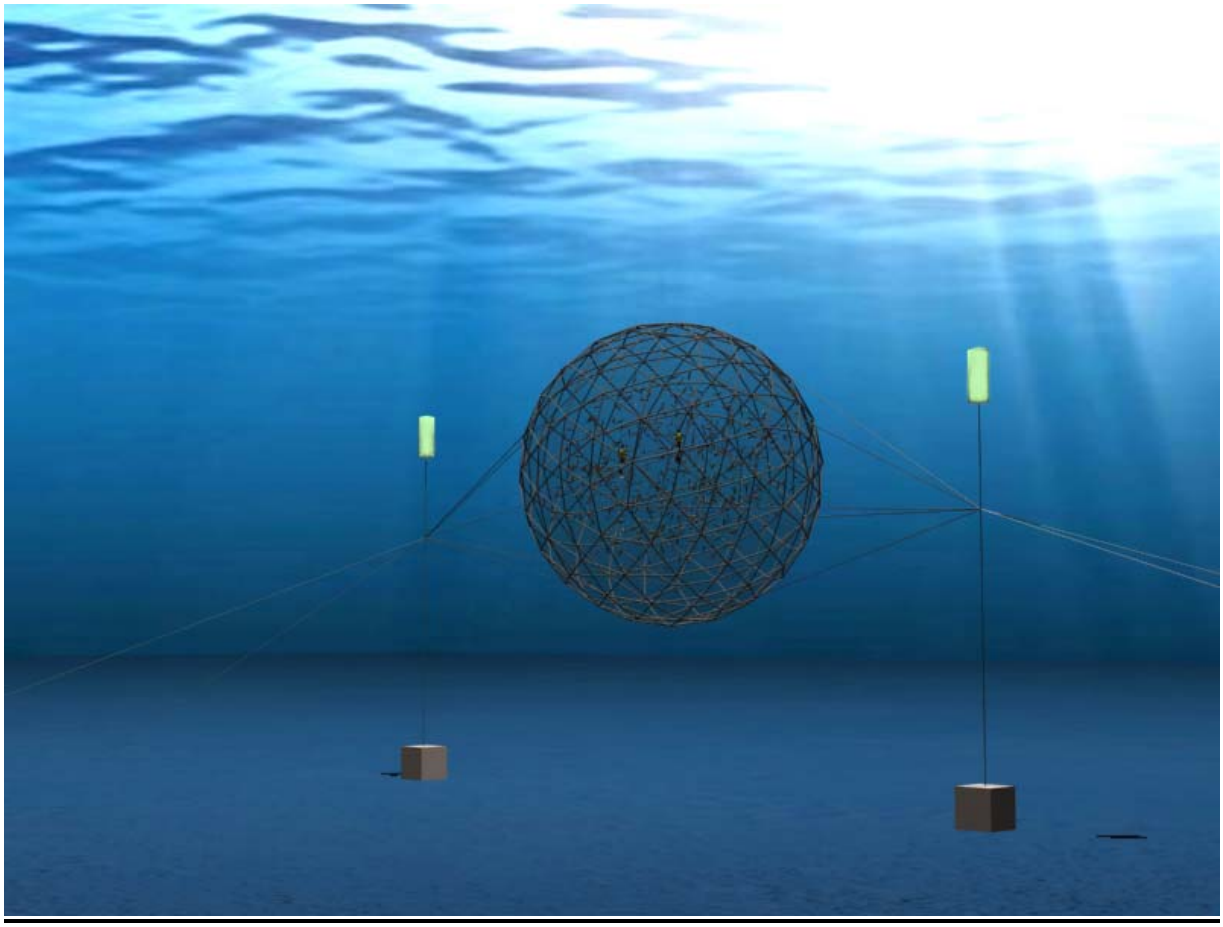

Figure 1. Illustration of an Aquapod designed by Ocean Farm Technologies, www.oceanfarmtech.com

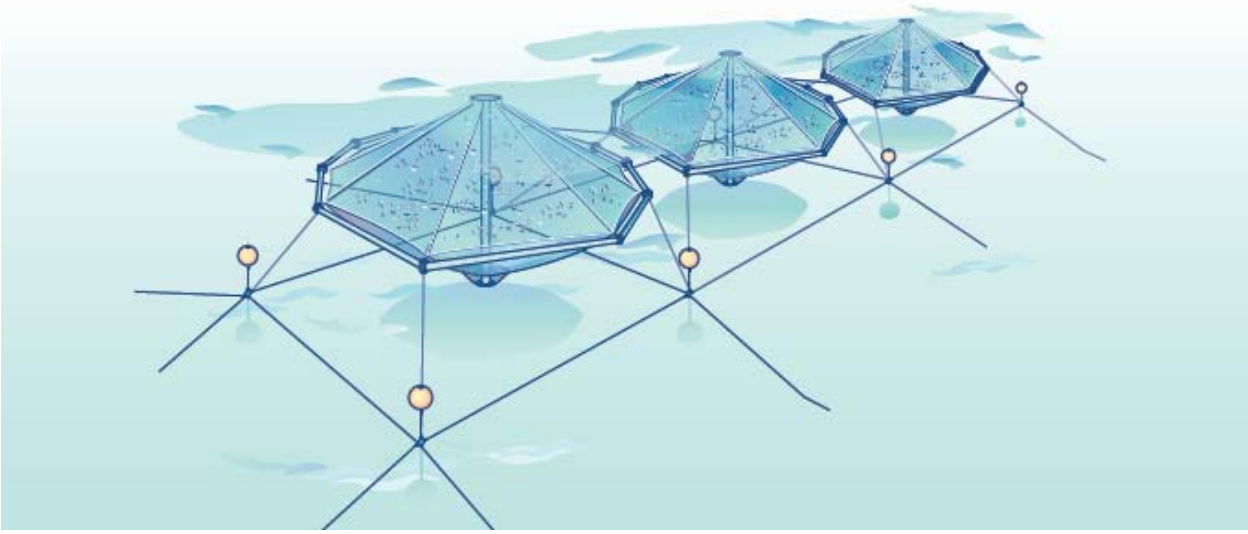

Figure 2. Illustration of Open Ocean Sea Station by Ocean Spar, www.oceanspar.com

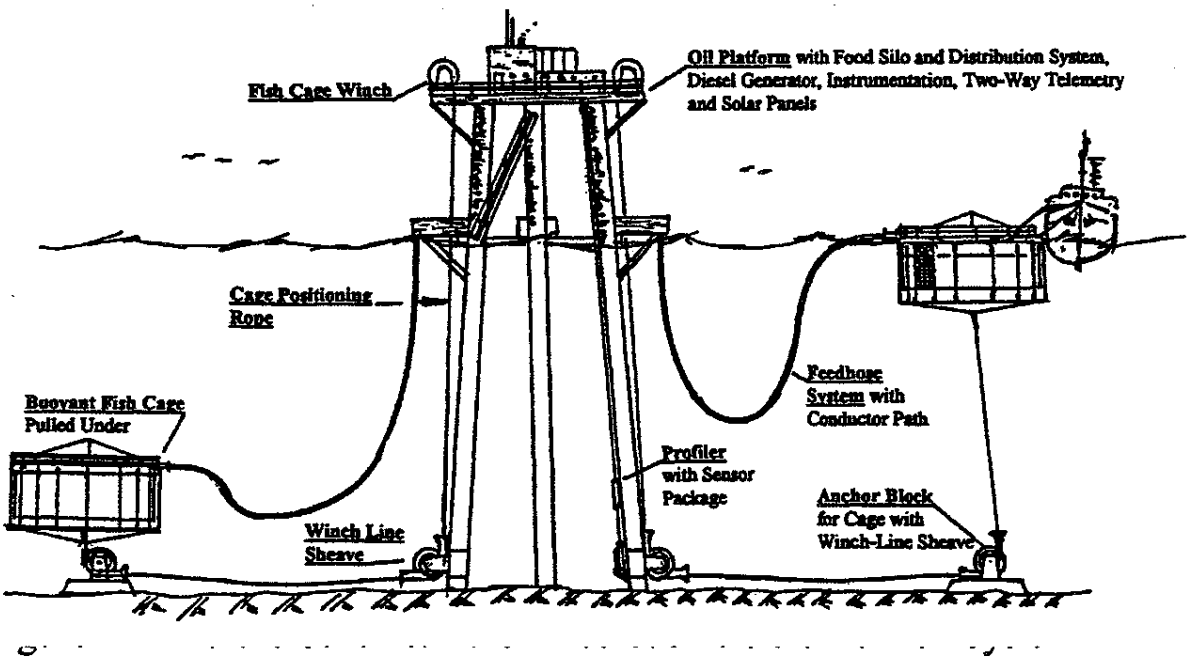

Figure 3: Oil platform with food silo and distribution system, diesel generator, instrumentation, two-way telemetry and solar panels. Source: Offshore Mariculture in the Gulf of Mexico: A Feasibility Report published by the Louisiana Sea Grant College Program, Sea Grant Building, Louisiana State University, Baton Rouge, Louisiana.

APPENDIX H - EPA EFFLUENT LIMITATIONS GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS FOR THE CONCENTRATED AQUATIC ANIMAL PRODUCTION POINT SOURCE CATEGORY

C. What Are the Requirement for the Net Pen Subcategory?

The following discussion explains the BPT/BAT/BCT limitations and NSPS EPA is promulgating for Net Pen Systems.

1. BPT
After considering the technology options described in the proposal and the factors specified in Section 304(b)(1)(B) of the Clean Water Act, EPA is establishing nationally applicable effluent limitations for net pen facilities producing 100,000 pounds or more of aquatic animals per year. Today's BPT regulations requires CAAP net pen systems, like CAAP flow-through and recirculating systems, to comply with specified operational practices and management requirements. These requirements are non-numeric effluent limitations based on technologies EPA has evaluated and determined are cost-reasonable, available technologies.

Based on the detailed survey results, EPA estimates that such programs are currently in use at most or all the net pen systems. As a result, the cost to facilities of meeting the BPT requirements is very low. To EPA's knowledge, all existing net pen facilities that are currently covered by NPDES permits are subject to permit requirements comparable to today's limitations. Therefore, EPA concludes that the BPT limits are both technically available and cost reasonable for the
net pen subcategory.

EPA rejected the establishment of numeric effluent limitations for net pens for obvious reasons. Because of the nature of the facilities, net pens cannot use physical wastewater control systems except at great cost. Located in open waters, nets are suspended from a floating structure to contain the crop of aquatic animals. Nets are periodically changed to increase the mesh size as the fish grow in order to provide more water circulating inside the pen. The pens are anchored to the water body floor and sited to benefit from tidal and current action to move wastes away from, and bring oxygenated water to, the pen. As a result, these CAAP facilities experience a constant in- and out-flow of water. Development of a system to capture the water and treat the water within the pen would be prohibitively expensive. EPA, therefore, rejected physical treatment systems as the basis for BPT limitations. Instead, EPA is promulgating narrative effluent limitations.

As was the case with flow-through and recirculating systems, feed management programs are a key element of the promulgated requirements for the reasons explained above and in the proposal at 67 FR 57872, 57887. Consequently, for the control of solids, the final regulation requires that net pen CAAP facilities minimize the accumulation of uneaten feed beneath the pen through the use of active feed monitoring and management practices. Sec. 451.21(a). These strategies may include either real-time monitoring (e.g., the use of video monitoring, digital scanning sonar, or upweller systems); monitoring of sediment quality beneath the pens; monitoring of the benthic community beneath the pens; capture of waste

feed and feces; or the adoption of other good husbandry practices, subject to the permitting authority's approval.

As noted, feed management systems are effective in reducing the quantity of uneaten feed. Facilities should limit the feed added to the pens to the amount reasonably necessary to sustain an optimal rate of fish growth. In determining what quantity of feed will result in minimizing the discharge of uneaten feed while at the same time sustaining optimal growth, a facility should consider, among others, the following factors: The types of aquatic animals raised, the method used to feed the aquatic animals, the facility's production and aquatic animal size goals, the species, tides and currents, the sensitivity of the benthic community in the vicinity of the pens, and other relevant factors. In some areas, deep water and/or strong tides or currents may prevent significant accumulation of uneaten feed such that active feed monitoring is not needed. Several states with significant numbers of net pens (e.g., Washington, Maine) already require feed management practices, which may include active feed monitoring, to minimize accumulation of feed beneath the pens. Facilities will need to ensure that whatever practices they adopt are consistent with the requirements of their state NPDES program.

In order to implement a feed management system, the facility must also track feed inputs by maintaining records documenting feed and estimates of the numbers and weight of aquatic animals in order to calculate representative feed conversion ratios. Sec. 451.21(g). As previously explained, development of feed conversion ratios are a necessary element in any effective feed management system.

Real-time monitoring represents a widely-used business practice that is employed by many salmonid net pen facilities to reduce feed costs. Net pen systems do not present the same opportunities for solids control as do flow-through or recirculating systems for the obvious reason that ocean water is continuously flowing in and out of the net pens. Therefore, in EPA's view, feed monitoring, including real time monitoring and other practices is an important and cost reasonable practice to control solids discharges.

The final rule includes a narrative limitation requiring CAAP net pen facilities to collect, return to shore, and properly dispose of all feed bags, packaging materials, waste rope and netting. Sec. 451.21(b). This will require that net pen facilities have the equipment (e.g., trash receptacles) to store empty feed bags, packaging materials, waste rope and netting until they can be transported for disposal. EPA is also requiring that net pens minimize any discharges associated with the transporting or harvesting of fish, including the discharge of blood, viscera, fish carcasses or transport water containing blood. Sec. 451.21(c). During stocking or harvesting of fish, some may die. The final limitations require facilities to remove and dispose of dead fish properly on a regular basis to prevent discharge. Discharge of dead fish represents an environmental concern because they may spread disease and attract predators, which could imperil the structural integrity of the containment system. The wastes and wastewater associated with the transport or harvest of fish have high BOD and nutrient concentrations and should be disposed of at a location where they may be properly treated.

The final regulations also require net pen facilities to ensure the proper storage of drugs, pesticides, and feed to avoid spilling these materials and subsequent discharge. See Sec. 451.21(e)(1) of this rule. Facilities must also implement procedures for properly containing, cleaning and disposing of any spilled material. See Sec. 451.21(e)(2) of this rule. As previously discussed, excess feed may present a number of different environmental problems. Preventing spills of feed is consequently important. Additionally, net pens may use different pesticides and drugs in fish production. Preventing their release is similarly important. The final regulation also includes a narrative limitation, similar to that for CAAP flow-through and recirculating systems, requiring that net pen facilities adequately train facility personnel in how to respond to spills and proper clean- up and disposal of spilled material. See Sec. 451.21(h) of this rule.

Next, the final regulation requires regular inspection and maintenance of the net pen Sec. 451.21(f). This would include any system to prevent predators from entering the pen. Net pens are vulnerable to damage from predator attack or accidents that result in the release of the contents of the nets, including fish and fish carcasses. Given the economic incentive to prevent the loss of production, EPA assumes facilities will conduct routine inspections of the nets to ensure they are not damaged and make repairs as soon as any damage is identified. Most net pen facilities are already doing these inspections. However, in evaluating this technology option, EPA estimated costs for increased inspections at every net pen facility in order to ensure that costs are not underestimated.

Like the final BPT limitations for flow-through and recirculating systems, the BPT limitations for net pens do not include any requirements specifically addressing the release of non-native species. The final regulation, however, includes a narrative effluent limitation that requires facilities to implement operational controls that will ensure the production facilities and wastewater treatment structures are being properly maintained. Facilities must conduct routine inspections and promptly repair damage to the production systems or wastewater treatment units. EPA included this requirement to ensure achievement of the other BPT limitations for net pens such as the prohibition on the discharge of feed bags, packaging materials, waste rope and netting at net pens, and the requirement to minimize release of solids, fish carcasses and viscera. This requirement will also aid in preventing the release of other materials including live fish.

2 BAT

EPA is establishing BAT at a level equal to BPT for the net pen subcategory. For this subcategory, EPA did not identify any available technologies that are economically achievable that would achieve more stringent effluent limitations than those considered for BPT. Because of the nature of the wastes generated from CAAP net pen facilities, EPA did not identify any advanced treatment technologies or practices to remove additional toxic and nonconventional pollutants that would be economically achievable on a national basis beyond those already considered.

3. BCT

EPA evaluated conventional pollutant control technologies and did not identify a more stringent technology for the control of conventional pollutants for BCT limitations than the

final requirements considered. Consequently, EPA has not promulgated BCT limitations or standards based on a different technology from that used as the basis for BPT limitations and standards.

4. NSPS

After considering the technology requirements described previously under BPT, and the factors specified in section 306 of the CWA, EPA is promulgating standards of performance for new sources equal to BPT, BAT, and BCT. There are no more stringent best demonstrated technologies available. Because of the nature of the wastes generated and the production system used, EPA has not identified advanced treatment technologies or practices that would be generally affordable beyond those already considered.

Although siting is not specifically addressed with today's standards, proper siting of new facilities is one component of feed management strategies designed to minimize the accumulation of uneaten feed beneath the pens and any associated adverse environmental effects. When establishing new net pen CAAP facilities, consideration of location is critical in predicting the potential impact the net pen will have on the environment. Net pens are usually situated in areas which have good water exchange through tidal fluctuations or currents. Good water exchange ensures good water quality for the animals in the nets. It also minimizes the concentration of pollutants below the nets. In implementing today's rule for new net pen operations, facilities and permit authorities should give careful consideration to siting prior to establishing a new net pen facility.

EPA has concluded that NSPS equal to BAT does not present a barrier to entry. The overall impacts from the effluent limitations guidelines on new source net pens are no more severe than those on existing net pens. The costs faced by new sources generally should be the same as, or lower than, those faced by existing sources. It is generally less expensive to incorporate pollution control equipment into the design at a new facility than it is to retrofit the same pollution control equipment in an existing facility.

Although EPA is not establishing standards of performance for new sources for small cold water facilities (i.e., those producing between 20,000 and 100,000 pounds of aquatic animals per year), such facilities would be subject to existing NPDES regulations and BPT/BAT/BCT permit limits developed using the permit writer's ``best professional judgment'' (BPJ). EPA, based on its analysis of existing data, determined that new facilities would most often produce 100,000 pounds of aquatic animals or more per year because of the expense of producing the aquatic animals. Generally, the species produced are considered of high value and are produced in such quantities to economically justify the production. For example, one net pen typically holds 100,000 pounds of aquatic animals or more. In reviewing USDA's Census of Aquaculture and EPA's detailed surveys, EPA has not identified any existing commercial net pen facilities producing fewer than 100,000 pounds of aquatic animals per year.

Offshore aquatic animal production is an area of potential future growth. As these types of facilities start to produce aquatic animals, those with 100,000 pounds or more per year will

be subject to the new source requirements established for net pens as well as NPDES permitting.

D. What Monitoring Does the Final Rule Require?

The final rule does not require any effluent monitoring. In the case of net pen facilities, however, it does require CAAPs to adopt active feed monitoring and management practices that will most often include measures to observe the addition of feed to the pen. Net pen facilities subject to today's rule must develop and implement active feed monitoring and management strategies to minimize the discharge of solids and the accumulation of uneaten feed beneath the pen. Many existing net pen facilities use a real-time monitoring system such as video cameras, digital scanning sonar, or upweller systems to accomplish this. With a real-time monitoring system, when uneaten feed is observed falling beneath the pen feeding should stop. Depending on the location and other site-specific factors at the facility, a facility may adopt other measures in lieu of real time monitoring. These may include monitoring of sediment or the benthic community quality beneath the pens, capture of waste feed and feces or other good husbandry practices that are approved by the permitting authority.

E. What Are the Final Rule's Notification, Recordkeeping, and Reporting Requirements?

The final rule establishes requirements for reporting the use of spilled drugs, pesticides or feed that result in a discharge to waters of the U.S. by CAAP facilities. This provision ensures that, any release of spilled drugs, pesticides and feed to waters of the U.S. are reported to the permitting authorities to provide them with necessary information for any responsive action that may be warranted. This will allow regulatory authorities to reduce or avoid adverse impacts to receiving waters associated with these spills. EPA is requiring that any spill of material that results in a discharge to waters of the U.S. be reported orally to the permitting authority within 24 hours of its occurrence. A written report shall be submitted within 7 days. Facilities are required to report the identity of the material spilled and an estimated amount.

EPA is retaining for the final rule the proposed requirement that CAAP facilities report to the Permitting Authority whenever they apply certain types of drugs under the following conditions. First, the permittee must report drugs prescribed by a veterinarian to treat a species or a disease when prescribed for a use which is not an FDA- approved use (referred to as ``extralabel drug use'') as described further below. Second, the permittee must report drugs being used in an experimental mode under controlled conditions, known as Investigative New Animal Drugs (INADs). In EPA's view, notifying the Permitting Authority is necessary to ensure that any potential risk to the environment resulting from the use of these drugs can be addressed with site-specific remedies where appropriate. EPA strongly encourages reporting prior to use where feasible, as this provides the Permitting Authority with the opportunity to monitor or control the discharge of the drugs while the drugs are being applied. EPA has not made this an absolute requirement, however, in recognition of the fact that swift action on the part of veterinarians and operators is sometimes necessary to respond to and contain disease outbreaks.

The reporting requirement applies to the permittee and imposes no obligation on the prescribing veterinarian. The reporting requirement for extralabel drug use is not in any way intended to interfere with veterinarians' authority to prescribe extralabel drugs to treat aquatic animals or other animals in accordance with FFCDA and 40 CFR Part 530. This reporting requirement is promulgated to ensure that permitting authorities are aware of the use at CAAPs of extralabel drugs when such use may result in the release of the drug to waters of the U.S. Because the use is likely to involve adding the drug directly to the rearing unit, EPA believes there is a probability that these drugs may be released to waters of the U.S.

The regulation requires that a permittee must provide a written report to the permitting authority within seven days of agreeing to participate in an INAD study and an oral report preferably in advance of use, but in no event later than seven days after starting to use the INAD. The first written report must identify the drug, method of application, the dosage and what it is intended to treat. The oral report must also identify the drug, method of application, and the reason for its use. Within 30 days after the use of the drug at the facility, the permittee must provide another written report to the permitting authority describing the drug, reason for treatment, date and time of addition, method of addition and total amount added.

EPA has similar reporting requirements for extralabel drug use except that EPA is not requiring a written report in advance of use.

The reporting requirement applies only to those drugs that have not been previously approved for their intended use. Reporting would not be required for EPA registered pesticides and FDA approved drugs for aquatic animal uses when used according to label instructions. Reporting would only be required for INAD drugs and drugs prescribed by a veterinarian for extralabel uses. Because these classes of drugs have not been fully evaluated by FDA for the potential environmental consequences of the use being made of them EPA considers reporting ensures the permitting authority has enough information to make an informed response if environmental problems do occur. EPA has included an exception to the reporting requirement for cases where the INAD or extralabel drug has already been approved under similar conditions for use in another species or to treat another disease and is applied at a dosage that does not exceed the approved dosage. The requirement that the use be under similar conditions is intended to limit the exception to cases where the INAD or extralabel drug use would be expected to produce significantly different environmental impacts from the previously approved use. For example, use of a drug that had been previously approved for a freshwater application, as an INAD in a marine setting would not be considered a similar condition of use, since marine ecosystems may have markedly different vulnerabilities than freshwater ecosystems. Similarly, the use of a drug approved to treat terrestrial animals used as an INAD or extralabel drug to treat aquatic animals would not be considered a similar condition of use. In contrast, the use of a drug to treat fish in a freshwater system that was previously approved for a different freshwater species would be considered use under similar conditions. EPA has concluded that when a drug is used under similar conditions it is unlikely that the environmental impacts would be different than those that were already considered in the prior approval of the drug.

The reporting requirements with respect to INADs are not burdensome. FDA regulations require that the sponsor of a clinical investigation of a new animal drug submit to the Food and Drug Administration certain information concerning the intended use prior to its use. Therefore, this information will be readily available to any CAAP facility that participates in an INAD investigation. Having advance information will enable the permitting authority to determine whether restrictions should be imposed on the release of such drugs.

EPA is also requiring all CAAP facilities subject to today's regulation to develop and maintain a Best Management Practices plan on site. This plan must describe how the permittee will achieve the required narrative limitations. The plan must be available to the permitting authority upon request. Upon completion of the plan, the permittee must certify to the permitting authority that a plan has been developed.

The proposal included a requirement to implement escape prevention practices at facilities where non-native species are being produced. EPA received comments supporting such controls to prevent the release of non-native species. EPA also received comments arguing against controls in this regulation because other authorities are already dealing with non-native species, and because of the complexities of determining what is a non-native species and when such species may become invasive. For example, species raised by Federal and State authorities for stocking may not be ``native," but would not generally impose a threat if escapes occurred.

Today's regulation does not include any requirements specifically addressing the release of non-native species. The regulation, however, includes a requirement for facilities to develop and implement BMPs to ensure the production and wastewater treatment systems are regularly inspected and maintained. Facilities are required to conduct routine inspections and perform repairs to ensure proper functioning of the structures. EPA included this requirement to promote achievement of BPT/BAT limitations on the discharge of feed bags, packaging materials, waste rope and netting at net pens, and on the discharge of solids, including fish carcasses and viscera at all facilities. This requirement, described in more detail in Section VI.D, will also aid in preventing the release of other materials, including live fish.

The final regulation also includes a requirement for facilities to report failures and damage to the structure of the aquatic animal containment system leading to a material discharge of pollutants. EPA realizes that most CAAP facilities take extensive measures to ensure structural integrity is maintained. Nonetheless, failures do occur with potentially serious consequences to the environment. The failure of the containment system can result in the release of sediment, fish and fish carcasses which, depending on the magnitude of the release, can have significant impacts on the environment. For net pen systems, failures include physical damage to the predator control nets or the nets containing the aquatic animals, which result in a discharge of the contents of the nets. Damage includes abrasion, cutting or tearing of the nets and breakdown of the netting due to rot or ultra-violet exposure. For flow-through and recirculating systems, a failure includes a collapse or damage of a rearing unit or wastewater treatment structure; damage to pipes, valves, and other plumbing fixtures; and damage or malfunction to screens or physical barriers in the system, which

would prevent the unit from containing water, sediment, and the aquatic animals. In the event of a reportable failure as defined in the NPDES permit, EPA is requiring CAAP facilities to report to the permit authority orally within 24 hours of discovering a failure and to follow the oral report with a written report no later than seven days after the discovery of the failure. The oral report must include the cause of the failure and the materials that have likely been released. The written report must include a description of the cause of the failure, the time elapsed until the failure was repaired, an estimate of the types and amounts of materials released and the steps that will be taken to prevent a recurrence. Because the determination of what constitutes damage resulting in a ``material'' discharge varies from one facility to the next, EPA encourages permitting authorities to include more specific reporting requirements defining these terms in the permit. Such conditions might recognize variations in production system type and environmental vulnerability of the receiving waters.

Today's regulation requires record-keeping in conjunction with implementation of a feed management system. As previously explained, EPA is requiring flow-through, recirculating and net pen CAAP facilities subject to today's regulation to keep records on feed amounts and estimates of the numbers and weight of aquatic animals in order to calculate representative feed conversion ratios. The feed amounts should be measured at a frequency that enables the facility to estimate daily feed rates. The number and weight of animals contained in the rearing unit may be recorded less frequently as appropriate. Flow-through and recirculating facilities subject to today's requirements must record the dates and brief descriptions of rearing unit cleaning, inspections, maintenance and repair. Net pen facilities must keep the same types of feeding records as described above and record the dates and brief descriptions of net changes, inspections, maintenance and repairs to the net pens.