Fixed Petroleum Platforms and Artificial Reefs as Essential Fish Habitat

Options Paper

Generic Amendment Number 4 to Fishery Management Plans in the Gulf of Mexico

Including Draft Environmental Impact Statement, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

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DRAFT ENVIRONMENTAL IMPACT STATEMENT COVER SHEET

Name of Action

Fixed Petroleum Platforms and Artificial Reefs as Essential Fish Habitat, Generic Amendment 4 to the Fishery Management Plans in the Gulf of Mexico Addressing Changes to Essential Fish Habitat designation for artificial substrate, Including Draft Environmental Impact Statement, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

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Type of Action

( ) Administrative ( ) Legislative
(X) Draft ( ) Final

Summary/Abstract

ABBREVIATIONS USED IN THIS DOCUMENT

Gulf Council	Gulf of Mexico Fishery Management Council
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EIS	Environmental Impact Statement
FMP	Fishery Management Plan
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	Habitat area of particular concern
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
SAFMC	South Atlantic Fishery Management Council
SMZ	Special Management Zone

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CHAPTER 1. INTRODUCTION

1.1 Purpose and Need

The Gulf of Mexico Fishery Management Council is concerned about the effect that the removal of structures serving as artificial reef habitat may have on reef fish fisheries in the Gulf of Mexico. An abundance of individuals of managed reef fish species have come to associate with these structures over the past several decades. Fisheries, both recreational and commercial, have come to utilize these platforms as sites to catch these fish and the habitat provided by these structures may be necessary to support viable fish populations and associated fisheries.

Artificial reefs are inhabited by a number of federally managed species and may provide important habitat necessary to fish for spawning, breeding, feeding or growth to maturity. The purpose of this action is to consider the role of this habitat as essential fish habitat (EFH) in accordance with the regulations at 50 CFR Part 600 Subpart J.

Purpose for Action

To determine if new information exists that demonstrates artificial substrates, including fixed petroleum leg platforms and artificial reefs, provide habitat functions to federally-managed species in the Gulf of Mexico meeting the criteria identified and described as essential fish habitat (EFH) in accordance with the regulations at 50 CFR Part 600 Subpart J.

Need for Action

The Magnuson Stevens Fisheries Conservation Management Act and EFH regulations require fishery management plans to identify and describe "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

1.2 Background

Gulf of Mexico Fishery Management Council

- Responsible for conservation and management of fish stocks
- Consist of 11 voting members who are appointed by the Secretary of Commerce; and 1 voting member representing each of the five Gulf states
- The Southeast Regional Director of NOAA Fisheries
- Develops fishery management plans and amendments; and recommends actions to NOAA Fisheries Service for implementation

NOAA Fisheries Service

- Responsible for preventing overfishing while achieving optimum yield
- Approves, disapproves, or partially approves Council recommendations
- Implements regulations

Fish require quality habitat for survival, growth, and reproduction. In cases of low quality or limited availability, habitat may limit population size for some species. To address this problem, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established a new requirement to describe and identify "essential fish habitat" (EFH) in each federal fishery management plan. The term "essential fish habitat" means those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

In addition to requiring federal fishery management plans to describe and identify EFH, the plans must also identify measures to minimize (to the extent practicable) adverse effects on such habitat caused by fishing, and to identify other actions to encourage the conservation and enhancement of such habitat.

Habitat Areas of Particular Concern

Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPC) are described in the EFH regulations as subsets of EFH which are rare; particularly susceptible to human-induced degradation; especially ecologically important; or located in an environmentally stressed area. EFH-HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to EFH-HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations.

Essential Fish Habitat Definitions

EFH is defined in the Magnuson-Stevens Act as "***...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.***" The rules promulgated by NOAA FISHERIES SERVICE in 1997 and 2002 further clarify EFH with the following definitions (50 C.F.R. 600.10 and 600.810):

- **waters** - aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate;
- **substrate** - sediment, hard bottom, structures underlying the waters, and associated biological communities;
- **necessary** - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and
- **spawning, breeding, feeding, or growth to maturity** - stages representing a species' full life cycle.
- **healthy ecosystem – means an ecosystem where ecological productive capacity is maintained, diversity of the flora and fauna is preserved, and the ecosystem retains the ability to regulate itself. Such an ecosystem should be similar to comparable, undisturbed ecosystems with regard to standing crop, productivity, nutrient dynamics, trophic structure, species richness, stability, resilience, contamination levels, and the frequency of diseased organisms.**

In 2004, the Gulf Council completed a Final Environmental Impact Statement (EIS) for the Generic Essential Fish Habitat Amendment (GMFMC 2004) addressing all required EFH components. As a result of the 2004 EFH EIS, the Gulf Council produced the 2005 Final Generic Amendment Number 3 for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Fishery Management Plans of the Gulf of Mexico (GMFMC 2005).

Currently, there are no oil and gas structures in any U.S. waters designated as EFH, and the Gulf Council has not previously identified artificial structures as a separate habitat type for EFH identification purposes or included them in their definition of "hard bottoms". In order for the National Marine Fisheries Service (NOAA Fisheries Service) to approve the Gulf Council's proposal to designate oil and gas structures as EFH, the Gulf Council must demonstrate, using the best available scientific information, the necessary linkage of the habitat functions to major

life history stages of species managed under the Magnuson-Stevens Act in accordance with the EFH regulations.

If the Gulf Council and NOAA Fisheries Service designate oil and gas structures (or other artificial structures) as EFH, they are required to consider actions to minimize the adverse impacts of fishing activities on such EFH. Additionally, Federal agencies would be required to consult on their actions that may adversely affect the quantity or quality of the newly designated EFH. Federal agencies are required to respond to NOAA Fisheries Service recommendations in writing with a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on such habitat. However, NOAA Fisheries Service's EFH conservation recommendations are advisory in nature and do not preempt the jurisdiction and regulatory oversight of other agencies on these structures.

The NOAA Fisheries Service currently consults with the Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE) programmatically on the installation and removal of oil and gas structures in the Gulf of Mexico. The NOAA Fisheries Service Southeast Region first completed a programmatic EFH consultation with BOEM/BSEE (formerly the Minerals Management Service or MMS) Gulf of Mexico Region in 1999. In 2012, a new programmatic EFH consultation was completed for the Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017 in the Western and Central Planning Areas of the Gulf of Mexico. These consultations cover a variety of oil and gas development activities including pipeline rights-of way, plans for exploration and production, and platform removal in the Gulf of Mexico. EFH conservation recommendations addressed avoidance and minimization measures to protect natural fish habitats from adverse effects of sighting, construction, and removal operations authorized by BOEM/BSEE.

Artificial Reefs in Gulf of Mexico Fisheries Management

An artificial reef is defined in the National Fishing Enhancement Act of 1984 (NFEA) (98th Congress 1984) as "a structure which is constructed or placed in waters ... for the express purpose of enhancing fishery resources and commercial and recreational fishing opportunities." The NFEA found that properly designed, constructed, and sited artificial reefs could enhance the habitat and diversity of fishery resources; enhance recreational and commercial fishing opportunities; increase production of fishery products; increase energy efficiency of recreational and commercial fisheries; and contribute to the United States and coastal economies. The National Artificial Reef Plan (NARP) (NOAA 2007) provides guidelines to be followed when selecting materials and sites for, and deploying, artificial reefs. The NARP also states that when properly constructed and sited, reefs can enhance fish habitat and augment fishery resource access. However, improperly constructed and/or sited reefs can create long-term problems. Planning, long-term monitoring, and evaluation are necessary to ensure designated artificial reefs are performing as designed. At minimum, artificial reefs should cause no harm to existing living marine resources and habitats. The NARP advises decision makers to be cautious when attempting to enhance existing habitat, as this augmentation "may alter the ecosystem by changing the biology, population dynamics, distribution, or species composition" (NOAA 2007).

The National Fishing Enhancement Act of 1984

The NFEA states that artificial reefs "shall be sited and constructed, and subsequently monitored and managed in a manner which will:

1) Enhance fishery resources to the maximum extent practicable;
2) Facilitate access and use by US recreational and commercial fishermen;
3) Minimize conflicts among competing uses of waters covered under this title and the resources in such waters;
4) Minimize environmental risks and risks to personal health and property; and
5) Be consistent with generally accepted principles of international law and shall not create any unreasonable obstruction to navigation."

Predictably, some anthropogenic materials are better suited for use as a means of habitat augmentation than others. The NARP describes four criteria to strongly consider when selecting materials: function, compatibility, stability, and durability. Most artificial reefs utilize materials or structures that were created to serve some other intended purpose. Accordingly, some of these materials are not recommended, including: wood; fiberglass; plastic; light vehicle bodies; fiberglass boats and boat molds; railroad boxcars; and kitchen and laundry appliances (NOAA 2007). Many materials historically used in artificial reef construction are described in the *Guidelines for Marine Artificial Reef Materials* (GMARM) (Lukens and Selberg 2004) and are presented in Table 1.2.1

Table 1.2.1 Materials historically used in marine artificial reef projects. Materials are listed with their projected lifespan in the marine environment and whether or not they are a recommended artificial reef material (NFEA, GMARM, NARP).

Material	Lifespan	Recommended?
Concrete	100+ years	Yes
Steel Hull Vessels	60 years	Yes
Oil and Gas Platforms	100+ years	Yes
Rail Cars	14 years	No
Designated Structures	100+ years	Yes
Military Battle Vehicles	100+ years	Yes
Wood	Unknown	No
Rock	100+ years	Yes
Fiberglass Boats/Molds	Unknown	No
Wooden Vessels	30 years	No
Automobiles	<5 years	No
Tires	100+ years	No

Artificial structures are prominent features of Gulf of Mexico ecosystems, having been placed there either for fishing enhancement (such as artificial reefs) or intended for other uses (e.g., petroleum production), but also indirectly serve as fish aggregating structures. The role of artificial structures in fishing enhancement has long been recognized and was included in the National Fishing Enhancement Act of 1984 (98th Congress 1984). The value of artificial reefs as habitat in the Gulf of Mexico has been discussed extensively in GMFMC (1998). In the Gulf of Mexico, two types of artificial reefs are recognized: 1) structures intentionally placed as artificial reefs and 2) structures such as oil and gas platforms that are intended for other purpose but do provide fish habitat. In the Gulf of Mexico, petroleum platforms have been in place since the 1940's and have increased in number to approximately 3,701 platforms as of 2009 (Figures 1.2.1–1.2.2). A variety of other structures in the Gulf also serve as artificial reefs including pipelines, and sunken vessels (Figure 1.2.3).

Artificial reefs are not currently utilized as part of any fishery management plan in the Gulf of Mexico. Though artificial reefs are numerous in the Gulf of Mexico, they occupy only a small fraction of total hard-bottom habitat. However, evidence suggesting detectable impacts from the presence of artificial reefs on managed fisheries exists (South Korea: Kim et al. 2011). Kim et al. (2011) found that artificial habitat could play an important role in the enhancement of sandfish (*Arctoscopus japonicus*) stocks.

A common thread in discussions concerning the use of artificial reefs as fishery management tools has been the "attraction versus production" argument, debating whether artificial reefs merely attract and concentrate fish from nearby habitats or actually augment fish production with new biomass in the area in which the artificial habitat is located (suggesting reef habitat is a limiting factor). The attraction versus production issue has been addressed in research and literature by several scientists and research managers, but the relative levels of each component, and the factors affecting them, have yet to be unequivocally resolved (Broughton 2012 and

references therein). This debate has also been considered "un-resolvable" by several Gulf of Mexico fisheries researchers (Shipp 1999, Shipp and Bortone 2009, Cowan et al. 2010) with respect to reef-associated species. Habitat limitation and whether or not artificial reefs provide critical habitat for increased production that would not otherwise be possible, is considered to be a key issue on this debate (Broughton 2012). The current inability to resolve this debate does not, however, negate the acknowledged benefits of artificial reefs with respect to fisheries management, namely through diversion of fishing pressure on and mitigation of lost natural hard-bottom habitat.

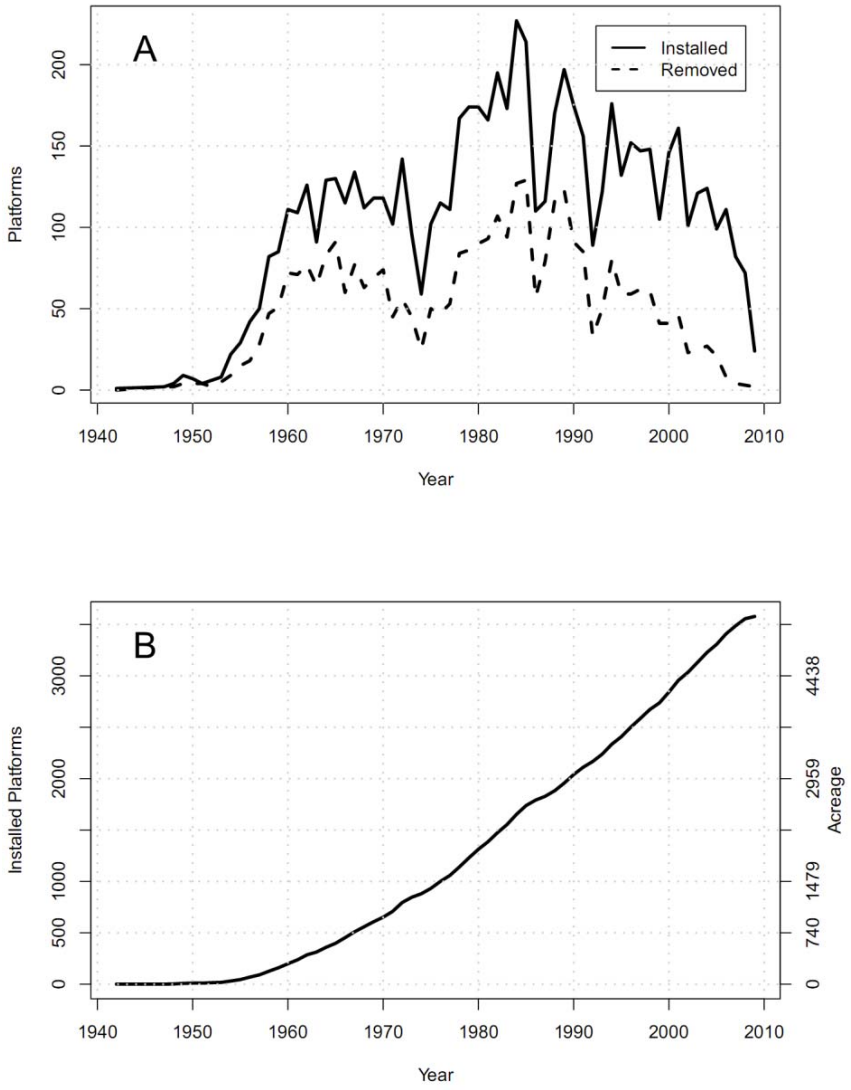


Figure 1.2.1. A) Number of petroleum platforms installed and removed each year in the Gulf of Mexico from 1942 to 2009. B) Cumulative total of platforms in place each year from 1942 to 2009. Note: 123 platforms are in place but had no listed installation date. Data included from 1942 to 2009. Source: BOEM.

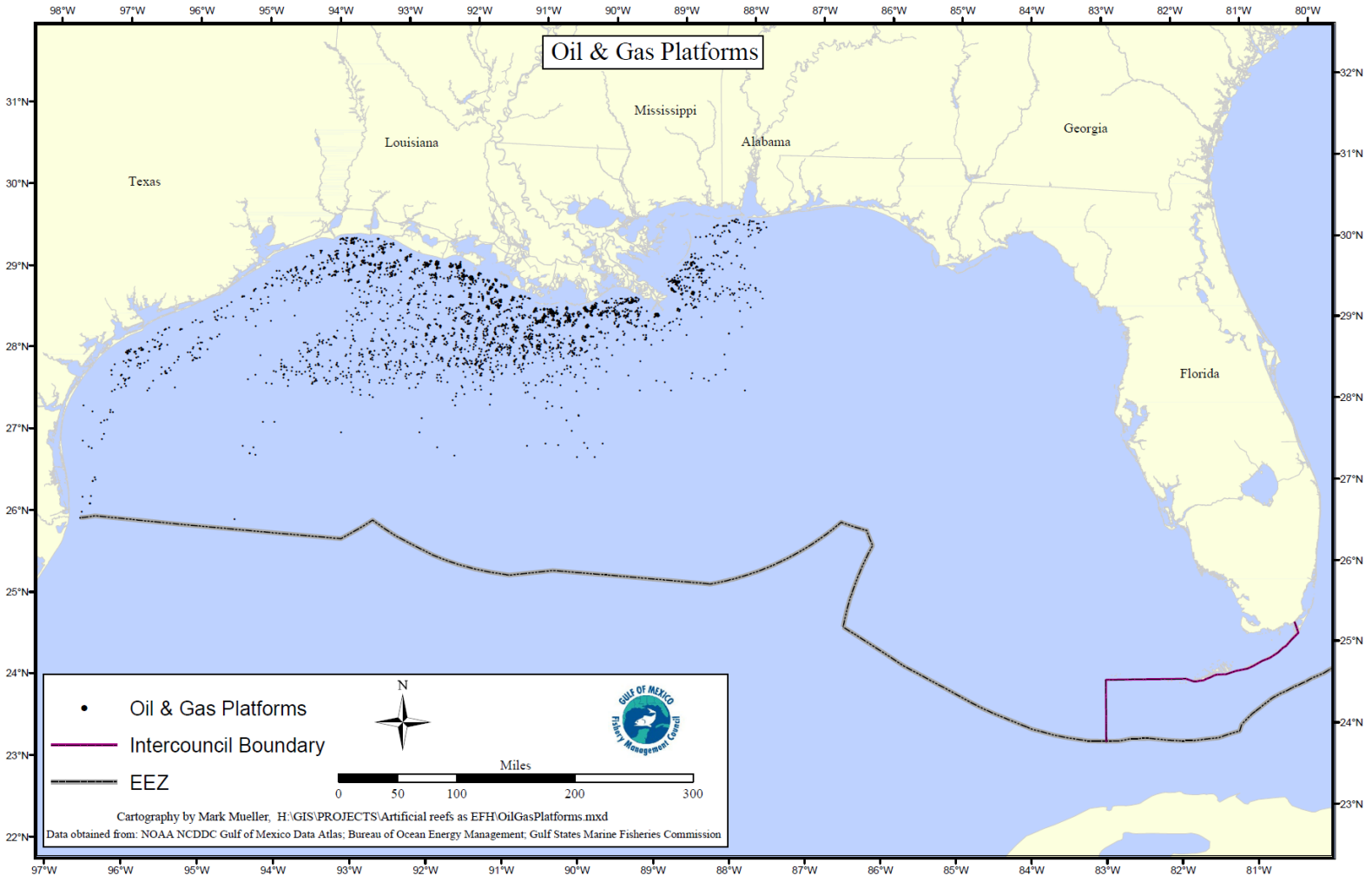


Figure 1.2.2. Active oil and natural gas platforms (n = 3,701), as of 2009.
Note: size of artificial structures not to scale- structures appear larger than they are to aid visual presentation.

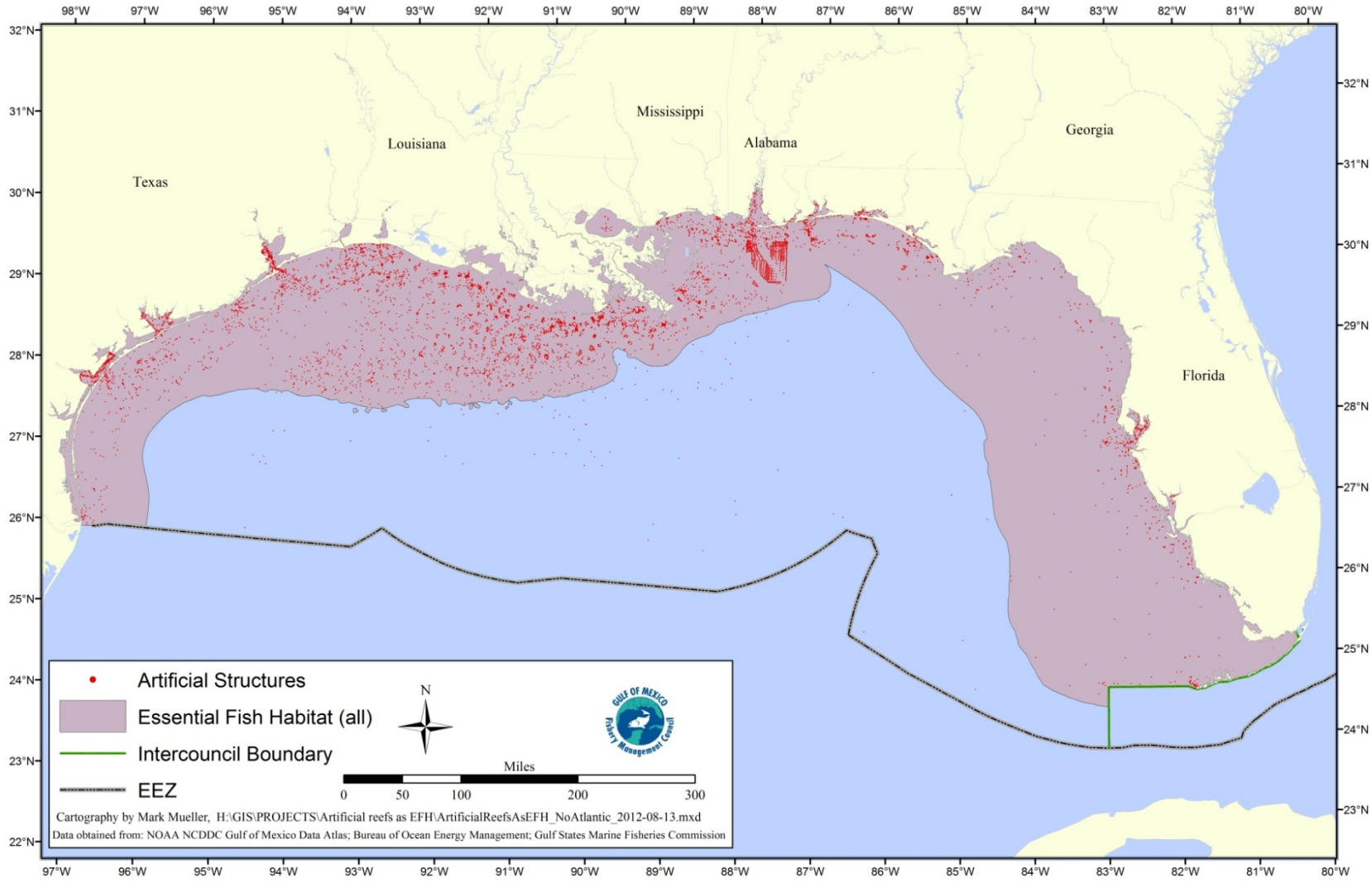


Figure 1.2.3. Composite of Essential Fish Habitat from all Gulf of Mexico Fishery Management Plans and locations of artificial structures (oil/gas platforms, state-compiled artificial reef databases, and NOAA Office of Coast Survey Shipwrecks and Obstructions).
Note: size of artificial structures not to scale- structures appear larger than they are to aid visual presentation.

Artificial reefs can be composed of a variety of materials, including concrete, wood, and steel among others. These man-made reef structures serve as settlement substrate for benthic sessile organisms such as corals, sponges, and molluscs. They also serve as a forage area and shelter habitat for a myriad of fish species in the Gulf of Mexico (i.e., reef fish assemblages – sensu Bohnsack et al., 1991). Despite their roles in creating fish habitat and increasing fishing opportunities, artificial reefs are not specifically identified and described as EFH in the Gulf of Mexico.

Several programs in the Gulf aim to conserve and protect artificial reef habitats. The Rigs to Reefs program works to convert obsolete, nonproductive offshore oil and gas structures into designated artificial reefs (http://www.boem.gov/search-results.aspx?q=rigs+to+reefs). Each of the Gulf states also have artificial reef programs, creating reefs with Reef Balls™, "grouper ghettos", and re-purposed concrete and steel structures such as pipes, oil and gas structures, and decommissioned ships. However, the Department of Interior's "idle iron" policy (Federal Register 2002) requires the removal of all platforms and other facilities within one year after the lease or pipeline right-of-way has terminated, unless special approval to maintain the structure or to conduct other activities is obtained (§250.1725). Though the idle iron policy may be in conflict with existing programs supporting artificial reefs, oil and gas structures themselves cannot be declared artificial reefs so long as they are producing oil and gas. As per the National Fishing Enhancement Act (NFEA 1984) definition of artificial reefs ("... a structure which is constructed or placed ... for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities"), oil and gas platforms cannot be designated as artificial reefs until such a time that their original purpose (oil and gas production) is no longer being served.

Though artificial reefs are not identified and described as EFH in the Gulf of Mexico, the vast majority of artificial reefs are located within, or placed upon habitat already identified as EFH for managed species (Figure 1.2.3). The South Atlantic Fishery Management Council (SAFMC) did identify and describe artificial/manmade reefs as EFH for both the South Atlantic snapper grouper complex and coastal migratory pelagic fisheries. The SAFMC defined manmade reefs as "any area within marine waters in which suitable structures or materials have intentionally been placed by man for the purpose of creating, restoring or improving long-term habitat for the eventual exploitation, conservation or preservation of the marine ecosystems naturally established on these sites." The SAFMC further discusses other manmade structures excluding them as EFH because "there is generally no direct intention in their design or placement to achieve specific fishery management objectives." Concurrently, the SAFMC designated much of the known artificial reef habitat in South Atlantic waters as special management zones (SMZs), allowing the SAFMC to prescribe effort limitations, such as those on destructive or overly-efficient fishing methods.

Table 1.2.2. Summary of estimated areas (sq. km and acres) of known artificial structures and naturally-occurring rocky substrate in the Gulf of Mexico**.**

CATEGORY	AREA (sq. km)	AREA (acres)
INSIDE EEZ (Gulf Council Jurisdiction)	626,830.81	154,892,652
Oil & Gas platforms (active)	20.49	5,062
State-Permitted Artificial Reef	0.09	22
Shipwrecks/Obstructions	0.25	61
All Artificial Structures combined area*	20.82	5,145
*Total area not additive—some areas overlap		
Substrate: rock dominant (>66%):	20,144.99	4,977,918
Substrate: rock subdominant (>33%):	6,790.12	1,677,868
Substrate: rock dominant or subdominant:	26,935.12	6,655,786
INSIDE EFH (including state waters)	349,136.46	86,273,155
Oil & gas platforms (active)	20.23	5,000
State-Permitted Artificial Reef	0.13	32
Shipwrecks/Obstructions	.74	183
All Artificial Structures combined area*	21.10	5,214
*Total area not additive—some areas overlap		
Substrate: rock dominant (>66%):	5,553.60	1,372,318
Substrate: rock subdominant (>33%):	6,664.27	1,646,769
Substrate: rock dominant or subdominant:	12,217.86	3,019,087

Hard substrate can be a determining factor for abundance of reef and reef-associated species. Petroleum platforms do increase the total hard bottom habitat in the Gulf. Estimates of hard-bottom provided by a single shallow-water platform range from 3,800 m^2 (Gallaway and Martin 1980) to 8,173 m^2 (Shinn 1974). Parker et al. (1983) estimated that petroleum platforms increased total reef habitat by 1.3%. Although the total number of oil and gas structures has increased since the 1983 Parker et al. study, the industry utilizes various types and configurations of structures making an approximation of the current extent of artificial hard bottom habitat unclear. However, it is clear that total hard bottom area provided by artificial reefs is minor compared to natural reefs (Table 2). If artificial reefs were to be considered EFH (apart from their inclusion within already designated EFH) in the Gulf of Mexico, an Amendment to the Generic Amendment Addressing Essential Fish Habitat Requirements in the Fishery Management Plans (FMP) of the Gulf of Mexico would be necessary. However, demonstration of the mechanism in which artificial structures serve as essential fish habitat would also be necessary with consideration to each species and respective life stages for which artificial

structures serve as essential fish habitat. If designated artificial reefs were to be identified and described as EFH, the Gulf Council must minimize (to the extent practicable) the impacts of fishing on the habitat per section 303(a)(7) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Also, federal agencies must then consult with NOAA Fisheries Service on federal actions that may adversely affect EFH. Importantly, NOAA Fisheries Service recommendations for the conservation of essential fish habitat are advisory and non-binding to the federal action agency. The EFH designation does not give the Gulf Council or NOAA Fisheries Service any additional regulatory authority, especially with regard to oil and gas platforms regulated by other federal or state agencies.

1.3 History of Management

In 1998, the Gulf Council amended the seven Fishery Management Plans (FMPs) of the Gulf of Mexico identifying and describing EFH based on where various life stages of 26 representative managed species and the coral complex commonly occur. The selected species accounted for about a third of the species under management and were selected because they were considered ecologically representative of the remaining species within the respective FMPs. In 2000, because of a lawsuit brought by a coalition of environmental groups, NOAA Fisheries' decisions on EFH amendments by several Fishery Management Councils (including the Gulf of Mexico Council) were found to be in accordance with the Magnuson-Stevens Act but in violation of the National Environmental Policy Act (NEPA). NOAA Fisheries was ordered to complete new, more thorough NEPA analyses for each EFH amendment in question.

The EFH Final Rule (50 C.F.R. Part 600) provides regulations and guidance on the implementation of the EFH provisions of the Magnuson-Stevens Act. It provides guidance on the types of information that can be used for describing and identifying EFH, designating EFH-HAPCs, and mitigating fishing impacts on EFH. The guidelines suggest using information in a risk-averse fashion to ensure adequate protection of habitat for all species in the management units.

In 2004, the Gulf Council completed a Final Environmental Impact Statement for the Generic Essential Fish Habitat Amendment (GMFMC 2004) addressing all required EFH components. As a result of the 2004 EFH EIS, the Gulf Council produced the 2005 Final Generic Amendment Number 3 for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Fishery Management Plans of the Gulf of Mexico (GMFMC 2005).

Although the EFH designations appear to be very expansive, encompassing most of the coastal waters and Exclusive Economic Zone (EEZ), it is important to realize that all EFH is the sum of the separate EFH designations for many managed species. Each species has two to four distinct life stages and seasonal differences in habitat requirements, thus a species can require many habitats. Careful and deliberate consideration by NOAA Fisheries Service and the GMFMC was taken in designating the extent of EFH.

A comprehensive review of scientific literature provided information on the relationship between managed species and habitats and the ecological functions supported. The following life stages were used to coincide with the statutory language defining EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding and growth to maturity": eggs, larvae, post-larvae, early juveniles, late juveniles, adults, and spawning adults. Preferences for habitat types and substrates, water depth, salinity, temperature, and dissolved oxygen tolerances were incorporated in a relational database. Using information on distributions of life stages of Gulf of Mexico FMP species, a density status was applied to each species life-stage in each eco-region. Although information was available for many juvenile and adult life stages, there was a general lack of existing information for the earliest life history stages. When substrate and depth preferences or geographic density status was not available for certain life stages, information on

other life stages of the same species or same life stage information of a similar species was used when possible.

The Gulf Council utilized twelve habitat types to provide consistent terminology, as data were collected from various sources. The twelve habitat types were also categorized by zone:

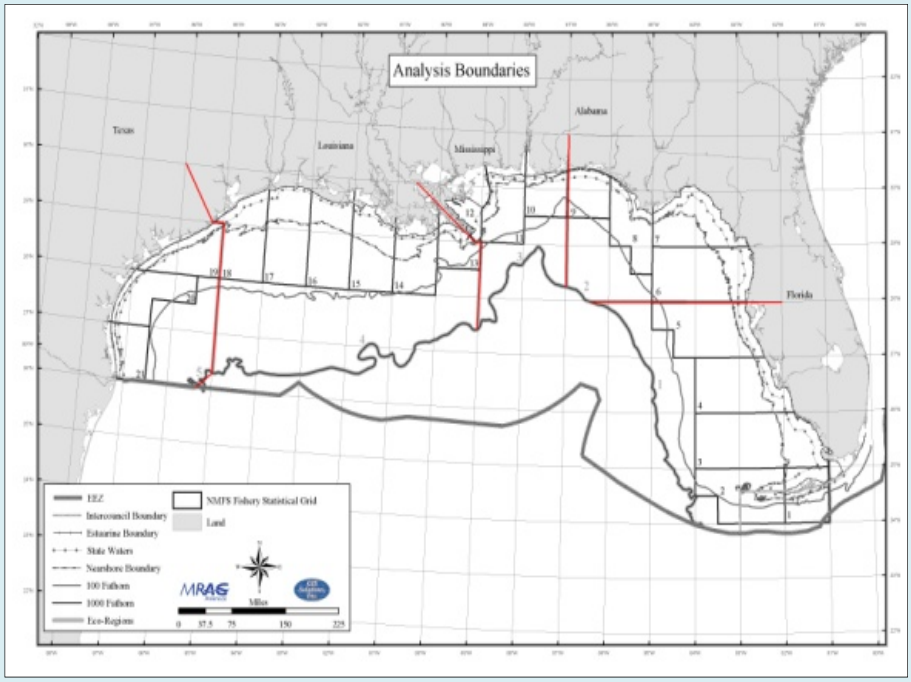
- Estuarine: Inside barrier islands and estuaries
- Nearshore: Waters 60-feet or less in depth
- Offshore: Waters greater than 60-feet depth

Habitat Type:	Related Terms:
• Submerged Aquatic Vegetation	seagrasses, benthic algae
• Mangroves	
• Emergent Marsh	tidal wetlands, salt marshes, tidal creeks
• Drift Algae	
• Oyster Reefs	
• Reefs	reefs, reef halos, patch reefs, deep reefs
• Hard Bottom	live bottom, low- and high-relief bottoms
• Soft Bottom	mud, clay, silt
• Sand/Shell Bottom	sand
• Banks/Shoals	
• Shelf edge/slope	shelf edge, shelf slop
• Pelagic	

To further refine the analysis, the Gulf of Mexico was subdivided into five sub-units identified as "eco-regions". For convenience, the eco-regions were selected to coincide with existing statistical grid boundaries used by NOAA Fisheries Service for depicting fishing effort. The division between the eco-regions was based primarily on logical ecosystem subdivisions of the Gulf of Mexico.

Gulf of Mexico
Eco-Regions

1. **South Florida**: Florida Keys to Tarpon Springs.
2. **North Florida**: Tarpon Springs to Pensacola Bay
3. **East Louisiana, Mississippi, and Alabama**: Pensacola Bay to the Mississippi Delta
4. **East Texas and West Louisiana**: Mississippi Delta to Freeport
5. **West Texas**: Freeport to Mexico border



Note: Map describing boundaries (red lines) between eco-regions in the Gulf of Mexico management region.

Geospatial habitat information was gathered from a variety of state and federal agencies and academic institutions. The functional relationship analysis was utilized to select habitat polygons that fit within the criteria that identified species and lifestage utilization for the ecological functions. EFH maps were derived by selecting higher density polygons based upon each variable. The maps depicting these density and habitat utilization data were deliberated by the Gulf of Mexico FMC in developing the following textual (regulatory) descriptions of EFH for Gulf of Mexico Fishery Management Plans:

The 2005 EFH Amendment delineated EFH as areas of higher species density, based on the NOAA Atlas (NOAA 1985) and functional relationships analysis for the Red Drum, Reef Fish, Coastal Migratory Pelagics, Shrimp, Stone Crab, and Spiny Lobster FMPs; and on known distributions for the Coral FMP. Specifically, EFH consists of the following waters and substrate areas in the Gulf of Mexico:

Red Drum FMP: all estuaries; Vermilion Bay, Louisiana, to the eastern edge of Mobile Bay, Alabama, out to depths of 25 fathoms; Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; and Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council (SAFMC) between depths of 5 and 10 fathoms.

Reef Fish and Coastal Migratory Pelagics FMPs: all estuaries; the US/Mexico border to the boundary between the areas covered by the GMFMC and the SAFMC from estuarine waters out to depths of 100 fathoms.

Shrimp FMP: all estuaries; the US/Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms.

Spiny Lobster FMP: from Tarpon Springs, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; and Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 15 fathoms.

Coral FMP: the total distribution of coral species and life stages throughout the Gulf of Mexico including: coral reefs in the North and South Tortugas Ecological Reserves, East and West Flower Garden Banks, McGrail Bank, and the southern portion of Pulley Ridge; hard bottom areas scattered along the pinnacles and banks from Texas to Mississippi, at the shelf edge and at the Florida Middle Grounds, the southwest tip of the Florida reef tract, and predominant patchy hard bottom offshore of Florida from approximately Crystal River south to the Florida Keys.

The EFH guidelines provide for the designation of subsets of EFH as habitat areas of particular concern (EFH-HAPC). The 2005 EFH Amendment identified several areas as HAPCs. Each proposed site is discrete, and meets one or more HAPC criteria:

1. Importance of ecological function provided by the habitat;
2. Extent to which the area or habitat is sensitive to human induced degradation;
3. Whether and to what extent development activities are stressing the habitat;
4. Rarity of the habitat type.

EFH-HAPCs were identified as the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and the individual reefs and banks of the Northwestern Gulf of Mexico: East and West Flower Garden Banks, Stetson Bank, Sonnier Bank, MacNeil, 29 Fathom Bank, Rankin Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Rezak Sidner Bank, Alderice Bank, and Jakkula Bank.

The Gulf of Mexico Council has addressed threats to habitat from fishing activities and has included management measures to minimize these adverse threats since the first fishery management plans were published in the late 1970s. No new management measures or regulations were proposed in the 1998 EFH Amendment.

The Council's 2004 EFH EIS utilized a fishing gear sensitivity index and fishing effort to analyze the relative risk of impacts to EFH resulting from various fishing activities. The 2005 EFH Amendment proposed four additional measures to prevent, mitigate, or minimize the adverse effects of fishing on EFH in the Gulf of Mexico. These measures were to:

1. Prohibit bottom anchoring over coral reefs in HAPC (East and West Flower Garden Banks, McGrail Bank, Pulley Ridge, and North and South Tortugas Ecological Reserves) and on the significant coral communities on Stetson Bank.

2. Prohibit use of trawling gear, bottom longlines, buoy gear, and all traps/pots on coral reefs throughout the Gulf of Mexico EEZ (East and West Flower Garden Banks, McGrail Bank, Pulley Ridge, and North and South Tortugas Ecological Reserves) and on the significant coral resources on Stetson Bank.

3. Require a weak link in the tickler chain of bottom trawls on all habitats. A weak link is defined as a length or section of the tickler chain that has a breaking strength that is less than the chain itself and is easily seen as such when visually inspected.

4. Establish an education program on the protection of coral reefs when using various fishing gears in coral reef areas for recreational and commercial fishermen.

The Gulf Council's 2004 EFH EIS (Page 2-26, GMFMC 2004) briefly discusses artificial structures and EFH. The following points are excerpted from the document:

- The Gulf Council has had considerable discussion regarding artificial structures (e.g., structures associated with oil and gas extraction, artificial reefs of varying size and construction) status as potential EFH.

- Artificial structures can be considered to be analogous to hard bottom, although the extent to which this analogy holds true is unknown. In fact, these structures represent a large number of "pinpoints" spread over the geographic space of the whole Gulf, rather than distinct parcels of habitat that could be portrayed as habitat polygons on a map.

- To the extent that artificial structures are located within the area described and identified as EFH, any future action that is likely to affect the way in which they provide habitat to managed species will be subject to the EFH consultation process.

- Artificial structures have not been identified as a separate habitat type in the EFH analysis.

In 2010, the Gulf Council completed a 5-year EFH review that reviewed existing EFH descriptions and designations by life stage for errors (GMFMC 2010). The Gulf Council evaluated new information available since the 2005 EFH Amendment but did not recommend any changes to existing EFH descriptions. Actions taken during the 5-year EFH review are included in Appendix E.

Designation of Artificial Substrates as EFH in other regions

South Atlantic Fishery Management Council

In 1998, the SAFMC Habitat Plan (SAFMC 1998) identified and described artificial / manmade reefs as EFH for both the South Atlantic snapper-grouper complex and for coastal migratory pelagic fisheries. The following points are excerpts from the Habitat Plan:

- Section 3.2.2.1, Artificial/Manmade Reefs Defined: "For all purposes within this document, manmade reefs are defined as any area within marine waters in which suitable structures or materials have intentionally been placed by man for the purpose of creating, restoring or improving long-term habitat for the eventual exploitation, conservation or preservation of the resulting marine ecosystems that are naturally established on these materials. In this light, manmade reefs should be viewed primarily as fishery management tools."
- Section 3.2.2.1.2, Function and Ecology of Manmade Reefs: Manmade reefs are deployed to change habitats from a soft substrate to a hard substrate system or to add vertical profile to low profile (< 1 m) hard substrate systems. These reefs are generally deployed to provide fisheries habitat in a specific desired location that provides some measurable benefit to humans.
- Section 3.2.2.1.3, Function and Ecology of Other Manmade Structures in the Marine Environment: Coastal engineering structures such as bridges, jetties, breakwaters and shipwrecks provide significant hard substrate for epibenthic colonization and development of an associated finfish assemblage. They differ from manmade reefs as defined above, in that there is generally no direct intention in their design or placement to achieve specific fishery management objectives.
- Section 3.2.2.4., Manmade Reefs in Marine Resource Management: Not all manmade structures that have been placed in U.S. waters can necessarily be considered essential or even effective fish habitat.
- The SAFMC established special management zones (SMZs) around artificial reefs and designated SMZs as habitat areas of particular concern within EFH (50 CFR 600.815(a)(8)).

Pacific Fishery Management Council (Pacific Council)

In 2005, the Pacific Council proposed in Amendment 19 to the Pacific Coast Groundfish FMP, to designate areas around oil production platforms in Southern California waters as HAPCs (NMFS 2005). The following points are excerpts from the Record of Decision for the Final Environmental Impact Statement supporting Amendment 19 to the Pacific Coast Groundfish FMP (NMFS 2006):

- NOAA Fisheries Service reviewed the available science related to oil production platforms and weighted public comment and determined there was insufficient evidence to designate the oil production platforms as HAPC.
- The record shows different and possibly contradictory information about the effect of oil platforms on groundfish.
- While the areas around the rigs are important enough for the groundfish fishery to be identified and described as EFH, the Council did not provide sufficient information to support the designation of these structures as HAPCS at this time.
- NOAA Fisheries Service will continue to consult with Federal Agencies on actions that may adversely affect EFH within the vicinity of oil platforms.

CHAPTER 2. MANAGEMENT ALTERNATIVES

Two actions are proposed considering habitat type designation of artificial substrates (Action 1) and an evaluation of the linkage of artificial substrates to the habitat function necessary for spawning, feeding, or growth to maturity to major life stage(s) of managed fish species (Action 2; Figure 2.1).

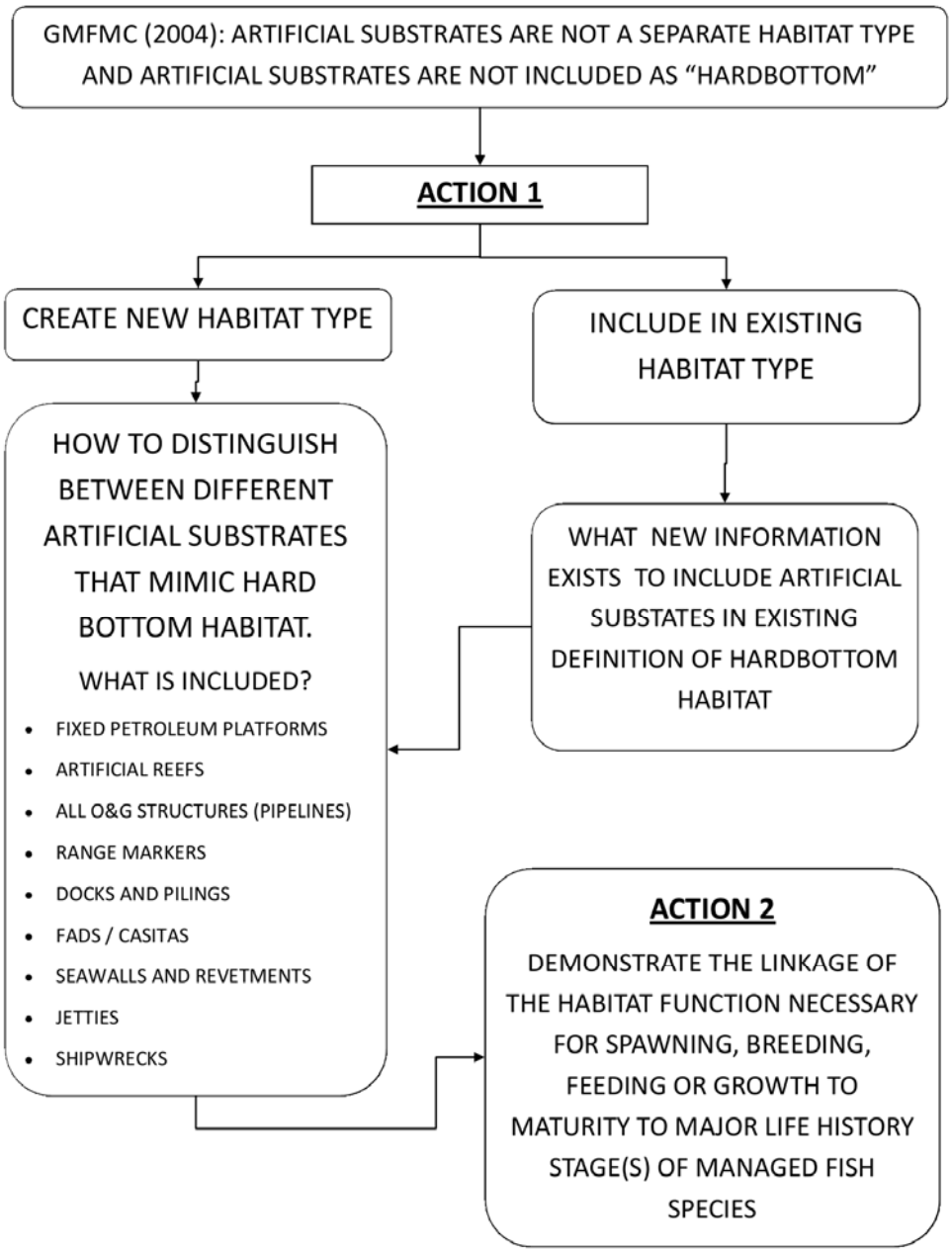


Figure 2.1. An overview of the proposed actions.

2.1 Action 1 – Habitat Type Designation for Artificial Substrates

Alternative 1: No Action - Do not identify any artificial substrates as a habitat type for purposes of designation as essential fish habitat (EFH).

Alternative 2: Designate artificial substrates as a **new habitat type** for potential identification and description as EFH.

Option 2a. Fixed Petroleum Platforms (FPP)
Option 2b. FPP and associated piping and other structures.
Option 2c. Artificial Reefs
Option 2d. Structures accidentally placed (wrecks, etc)
Option 2e. All artificial structures (range markers, pilings, docks, casitas, engine blocks, etc.)

Alternative 3: Designate **permitted** artificial substrates as a **new habitat type** for potential identification and description as EFH.

Option 3a. Fixed Petroleum Platforms (FPP)
Option 3b. FPP and associated piping and other structures.
Option 3c. Artificial Reefs
Option 3d. All permitted structures (range markers, pilings, docks, etc.)

Alternative 4: Recognize artificial substrates as **hard bottom habitat** as defined in Generic Amendment 3 (GMFMC 2005) for purposes of identifying and describing EFH

Option 4a. Fixed Petroleum Platforms (FPP)
Option 4b. FPP and associated piping and other structures
Option 4c. Artificial Reefs
Option 4d. Structures accidentally placed (wrecks, etc)
Option 4e. All artificial structures (range markers, pilings, docks, casitas, engine blocks, etc.)

Alternative 5: Recognize **permitted** artificial substrates as **hard bottom habitat** as defined in Generic Amendment 3 (GMFMC 2005) for purposes of identifying and describing EFH

Option 5a. Fixed Petroleum Platforms (FPP)
Option 5b. FPP and associated piping and other structures
Option 5c. Artificial Reefs
Option 5d. All permitted artificial structures (range markers, pilings, docks, etc.)

Discussion: Alternative 1 would not recognize artificial structures as a type of habitat and represents the status quo. **Alternative 1** would not permit evaluation of artificial substrates for potential identification and description as EFH.

The **Action Alternatives 2 – 5** would designate artificial structures as a recognized habitat type that would be subsequently evaluated for potential identification and description as EFH (**Action 2)**. **Alternatives 2 – 3** would create a new habitat type for artificial substrate whereas **Alternatives 4 – 5** would add artificial substrate as part of the recognized hard bottom habitat type based on similar species composition and ecological performance of artificial substrates and hard bottom habitat in the Gulf of Mexico.

In Alternative 2, five options (**options a – e**) are presented to identify which artificial substrates are appropriate for consideration. **Option 2a** would designate Fixed Petroleum Platforms (FPP) as a new habitat but would not consider other features (e.g., grouper ghettos, shipwrecks, pipelines) in the description of this new habitat type. There are approximately 4,000 FPP in the Gulf of Mexico although this number may be rapidly declining as idle platforms are removed. **Option 2b** would expand the features included in the new habitat type description in **Option 2a** by adding associated piping and structures of FPP to the substrates included in the new habitat type description. **Option 2c** would consider fishing enhancement reefs as a new artificial substrate although would not include FPP (i.e., **Options 2a, 2b**) or FPP and associated structures (i.e., **Option 2b**). **Option 2d** would only consider artificial structures that were accidentally placed inadvertently lost at sea (e.g., shipwrecks). **Option 2d** would not consider FPP, associated structures, or fishing enhancement reefs that are included in **Options 2a - 2c. Option 2d** would include the fewest number of structures of the **options** considered. In contrast, **Option 2e** is the most inclusive **option** as compared to **Options 2a – 2d** however, **Option 2e** could include structures as a part of a recognized habitat type that provide little benefit or cause ecological harm (e.g., trash).

Alternative 3 would designate permitted artificial substrates as a new habitat type. In contrast to **Alternative 2, Alternative 3** could alleviate problems of designating undesirable materials (i.e., ocean dumping) or structures as a recognized habitat type.

Alternative 3 considers four options. **Options 3a – 3c** would apply only to permitted structures but are otherwise identical to **Options 2a – 2c** described above. **Option 3d** is the most inclusive **Option d** under **Alternative 3** as it would include all permitted artificial structures as a new habitat type for potential description as EFH.

Alternative 4 would recognize artificial substrates as hard bottom habitat as defined in Generic Amendment 3 (GMFMC 2005) for purposes of identifying and describing EFH. In contrast to **Alternatives 2 - 3, Alternative 4** would not create a new habitat type. Instead, the structures indentified in **Options 4a – 4e** would be added to the existing definition of hard bottom. To identify structures appropriate for recognition, five options (**options a – e)** are presented in **Alternative 4** and are identical to the options described in **Alternative 2. Alternative 4** could recognize more structures than **Alternative 3** as unpermitted structures could also be included. However, as with **Alternative 2, Alternative 4** could provide a habitat type designation to undesirable structures (e.g., trash) that provide little or no benefit to habitat quality for managed fish species in the Gulf of Mexico.

Alternative 5 would recognize artificial substrates as hard bottom habitat as defined in Generic Amendment 3 (GMFMC 2005) as described in **Alternative 4**. In contrast to **Alternative 4, Alternative 5** would only consider permitted structures and could alleviate problems of designating undesirable materials (i.e., ocean dumping) as a recognized habitat type. Similar to **Alternative 4, Alternative 5** would add to the existing definition of hard bottom but not create a new habitat type. To identify structures appropriate for recognition, five options (**options a – e)** are presented in **Alternative 5** and are identical to the options described in **Alternative 3**.

2.2 Action 2 – Modify Fishery Management Plans and/or Policies of the Gulf of Mexico Fishery Management Council to recognize habitat value of artificial substrates

Alternative 1: No Action – Do not modify fishery management plans or habitat policy documents with regard to artificial substrates.

Alternative 2: Modify EFH identifications and descriptions for one or more federally managed species in accordance with 50. CFR 600.815.

Alternative 3: Modify existing **habitat policy** to recognize the importance of artificial substrates to federally managed species and participants in the reef fish fishery.

Discussion: Alternative 1 would not provide any habitat designation for artificial substrate and represents the status quo. However, the overwhelming majority of artificial substrates reside upon substrate or lies within a column of water that is already identified and described as EFH for one of more federally managed species/lifestages. For **Alternative 2**, the role of artificial substrate as defined in **Action 1** would be evaluated for each species/life stage to determine if this substrate functions as EFH or EFH-HAPC. If **Alternative 2** were selected, demonstration of the mechanism in which artificial structures serve as EFH or HAPC would also be necessary with consideration to each species and respective life stages for which artificial structures serve as essential fish habitat. If designated artificial reefs were to be designated as EFH, the Council must minimize (to the extent practicable) the impacts of fishing on the habitat per section 303(a)(7) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Also, all federal agencies must then consult with NOAA Fisheries on federal actions that may adversely affect EFH. EFH-HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to EFH-HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations. Based on the requirements of EFH and EFH-HAPC designation, it is uncertain if artificial substrates would satisfy these criteria. Despite any habitat designation made by the Gulf Council for artificial substrates, this would not extend any additional regulatory authority regarding structures intended for petroleum production.

Alternative 3 would allow the Gulf Council to develop a habitat policy identifying the importance of artificial substrates to federally managed reef species and participants in the reef fish fishery. Similar to **Alternative 2**, **Alternative 3** would not extend any additional regulatory authority to NOAA Fisheries Service as they can only make non-binding conservation recommendations regarding artificial substrates especially with regard to oil and gas platforms regulated by other federal or state agencies.

Mandatory Contents of Fishery Management Plans
Essential Fish Habitat Provisions
(50 C.F.R. 600.815(a))

(1) Description and Identification of EFH
- **i. Overview**
- **ii. Habitat information by life stage**
- **iii. Analysis of habitat information**
  - **A. Level 1. Distribution Data**
  - **B. Level 2. Habitat-Related Densities**
  - **C. Level 3. Growth, Reproduction, or Survival Rates within Habitats**
  - **D. Production Rates by Habitat**
- **iv. EFH Determination**
- **v. EFH Mapping Requirements**

(2) Fishing Activities That May Adversely Affect EFH
- **i. Evaluation**
- **ii. Minimizing adverse effects**
- **iii. Practicability**
  - **A. Fishing Equipment Restrictions**
  - **B. Time/Area Closures**
  - **C. Harvest Limits**

(3) Non-Magnuson-Stevens Act Fishing Activities That May Adversely Affect EFH

(4) Non-Fishing Related Activities That May Adversely Affect EFH

(5) Cumulative Impacts Analysis

(6) Conservation and Enhancement

(7) Prey Species

(8) Identification of Habitat Areas of Particular Concern
- **i. Importance of the ecological function provided by the habitat**
- **ii. Extent to which the habitat is sensitive to human-induced environmental degradation**
- **iii. Whether, and to what extent, development activities are, or will be, stressing the habitat type**
- **iv. The rarity of the habitat type**

(9) Research and information needs

(10) Review and Revision of EFH Components of FMPs

The EFH regulations require fishery management councils to identify non-fishing activities that have the potential to adversely impact EFH in order to support recommendations for actions to prevent the degradation or loss of such habitat. In GMFMC (2004) the Council discusses Oil

and Gas Operations (Section 3.5.3.1.6), Pipeline, Cables, and Rights-of-Way (Section 3.5.3.1.2) as such activities.

The EFH regulations also require councils to "identify actions to encourage the conservation and enhancement of EFH" including recommended options to avoid, minimize, or compensate for the adverse effects identified by fishing and non-fishing activities. In GMFMC (2004) the Gulf Council incorporated Section 7.2 of GMFMC (1998) to satisfy that requirement. The Gulf Council's current conservation recommendations encourage the removal of "abandoned" structures and restoring production and exploration sites to their original condition upon cessation of drilling or production activities.

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APPENDIX A. EFH IN THE GULF OF MEXICO

The Southeast Region Habitat Conservation Division is in the process of producing an updated guide to replace the existing "Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate For Federal Agencies, Gulf of Mexico Region" (REV 09/2010).
Add when available

APPENDIX B. SUMMARY OF 2005 EFH REVIEW

The following actions were taken during the five year review conducted in 2005 of the Gulf of Mexico Fishery Management Council's Generic Essential Fish Habitat Amendment:

1. Reviewing existing EFH descriptions and designations by life stage for errors

   The Council determined that minor discrepancies existed between habitats described graphically using maps and textual descriptions. The textual descriptions were determined to be more accurate than maps, and, in the event of a discrepancy between maps and text, fisheries managers were directed to rely on textual descriptions. In 2008, NOAA Fisheries Service took the necessary steps to resolve these discrepancies.

2. Evaluating new information available since the 2005 EFH Amendment for EFH descriptions and designations

   a. **Coastal Migratory Pelagics**: No new information
   b. **Coral**: *Lophelia. pertusa* appears to structure the surrounding slope community largely through the provision of habitat rather than food (CSA International, Inc. 2007). Barnette (2006) recorded extensive colonies of *Oculina varicosa* off the west Florida shelf in an area known as the Twin Ridges. Church et al. (2007) examined World War II era shipwrecks in the Gulf of Mexico and noted that *O. varicosa* was located on a shipwreck in 87 m of water. Weaver et al. (2006a) examined high-resolution multibeam bathymetry of Sonnier Bank and found at least a dozen additional lower relief peaks associated with the feature. Weaver et al. (2006a) stated that McGrail Bank contained extensive growth of hard corals dominated by blushing star coral (*Stephanocoenia intersepta*), large brain coral (*Diploria strigosa* and *Montastrea cavernosa*), and a species of *Agaricia*. Zimmer et al. (2006) discovered a colony of elkhorn coral in 2003 at the top of West Florida Garden Bank in 21.6 m of water. In 2005, researchers found another colony at the East Flower Garden Bank at a depth of 23.5 m. Precht and Aronson (2004) theorize that staghorn and elkhorn coral are expanding their ranges into the northern Gulf of Mexico, coincident with increasing sea temperatures.
   c. **Red Drum**: Gain (2009) determined that in the absence of predation, the presence of structured habitat did not influence juvenile red drum habitat selection; however, oyster reefs may function similarly to seagrass or marsh edge habitat types and may provide a refuge from predation for some fish and crustaceans. Holt (2008) determined that red drum spawn all along the nearshore region of the central Texas coast, but that the survey was not spatially broad enough to fully delineate the spawning area, while making it clear that red drum spawning activity is widespread and not concentrated at inlets or passes. Rooker et al. (2010) state that otolith δ13C and δ18O are viable markers of nursery origin and can be used to assess contribution rates of different nurseries to adult populations

of red drum. They also report that mixing occurs between regional estuaries in the Gulf, but the majority of adult red drum appear to either remain close to their nursery estuary or even return to their nursery area after a dispersive phase. Stunz et al. (2002a) stated the growth potential for red drum was significantly higher in marsh and seagrass enclosures, but growth results in enclosures should be evaluated carefully, because fish movement between the different habitats may be important in these shallow estuarine systems. Stunz et al. (2002b) state that even though red drum densities were lower at the marsh edge interface, marsh areas are much more extensive in Galveston Bay than seagrass.

d. **Reef Fish**: Acosta et al. (2007) determined that seagrass beds served as important habitat for small and juvenile fishes, especially lane snapper (*Lutjanus synagris*) and hogfish (*Lachnolaimus maximus*). Coleman et al. (2010) concluded that active sediment removal by red grouper increases biological diversity by exposing rocky substrate that provides settlement sites for sessile organisms and increases architectural complexity, which attracts many reef associated species and provides shelter for juvenile stages of some economically important species. Cook (2007) stated that in the western and central Gulf of Mexico, yellowedge grouper appeared to prefer mostly soft substrate, but were found associated with smaller reef and rock patches, outcroppings, sinkholes, pockmarks and ledges in the eastern Gulf of Mexico. Faunce and Serafy (2007) conclude that mangrove snapper shift from utilizing seagrass to mangroves after approximately eight to ten months and at a size of 10.5 to 12 cm total length. Frias-Torres (2006) found that juvenile goliath grouper aggregated in areas at least 80 cm deep during high and flood tides, with undercuts and/or well-developed canopy and overhangs, which provide both shade and structural complexity underwater. Koenig and Coleman (2006) examined near shore areas for juvenile red grouper and found that red grouper were always found in association with exposed solution holes in hard-bottom areas that were in water depths of 2 to 4 m. Koenig et al. (2007) reported that goliath grouper remained in mangroves for 5 to 6 years until they were approximately one meter in length before they left for offshore habitats. Lindberg et al. (2006) conclude that if the objective of building artificial reefs is to enhance gag stocks then they should be small, widely scattered patch reefs with appropriately sized cavities as these reefs can enhance the biological production of gag. Luo et al. (2009) found that mangrove snapper exhibit a pattern where shallow seagrass beds are frequented nocturnally and mangroves and other habitats with complex structure are occupied diurnally. Lyczkowski-Shultz and Hanisko (2007) reported that while larvae were captured throughout the survey area, they were captured in greatest abundance on the middle of the continental shelf west of the Mississippi River. Mikulas and Rooker (2008) conclude that Heald Bank, Sabine Bank, and Freeport Rocks all serve as settlement habitat for lane snapper, and that lane snapper appear to be capable of successful settlement across a variety of habitats. Patterson et al. (2005) found that juvenile red snapper density was significantly higher in areas with shell rubble or sponge habitat, thus indicating juvenile red snapper prefer habitat with small-scale complexity. Patterson et al. (2005) also stated that the scale of habitat complexity required by red snapper increases with fish size and age. Rooker et al. (2004) concluded that

the recruitment potential of red snapper residing in the inshore mud habitat was greater than for individuals using shell bank or offshore mud habitat. Weaver et al. (2006b) postulate that Miller's Ledge may be a potential spawning location for both commercially important and rare deep reef species, and as a potential source of larval recruits for the Florida Keys and other deep reef ecosystems of Florida. Wells and Cowan (2007) stated that juvenile red snapper were predominately collected over low relief sand habitats, while sub-adult and adult red snapper were found over higher relief habitats such as the shell-rubble and natural hard-bottom reef habitats. Wells and Rooker (2004a) concluded that because of the abundance of juvenile fish collected in association with *Sargassum* that these mats serve as important nursery habitat for pelagic fish. Wells and Rooker (2004b) state that *Sargassum* appears to provide important nursery habitat for young of the year greater amberjack.

e. **Shrimp**: Clark et al. (2004) determined that juvenile brown shrimp less than 100 mm selected vegetated habitats in salinities of 15−25 ppt and that seagrass was preferred over marsh edge when these two habitats were found in close proximity. Marsh edge was the preferred habitat in areas where seagrass was absent. Caudill (2005) stated that higher crustacean biomass within mangrove habitat was due to greater structural complexity of mangroves over marsh habitat, and that most crustaceans found in mangrove habitats were juvenile white shrimp and brown shrimp. Fry et al. (2003) found that by combining estimates of shrimp densities, residency, growth rate, and mortality allows evaluation of the importance of different habitat types for shrimp production. Fry (2008) found that marsh areas supported about 33% of total shrimp production while open bays supported 67% of Louisiana's brown shrimp production. King and Sheridan (2006) found that new seagrass beds seem to function as well as marsh habitat when it comes to secondary production, and researchers did not see a net change in secondary production. Reese et al. (2008) found that penaeid shrimp were able to disperse into the upper Laguna Madre via other tidal inlets before the opening of Packery Channel, but they found a significant increase in juvenile penaeid shrimp in adjacent habitats after the opening. Roth et al. (2008) concluded that sea level rise and marsh erosion affect competing positive effects of shrimp access to vegetation versus the negative effects of marsh loss. Rozas and Minello (2006) found that *Vallisneria* may provide an important nursery habitat for young white shrimp that use oligohaline estuarine areas. Rozas et al. (2007) found that populations of brown and white shrimp respond positively to marsh restoration. Shervette and Gelwick (2008) state that juvenile white shrimp may select for oyster reefs over non-vegetated bottom because of higher quality food or higher abundances of target food resources and not for refuge needs, and that juvenile white shrimp habitat needs shift with individual growth.

f. S**piny Lobster**: Hard-bottom communities containing macroalgae were found to be superior juvenile habitat compared to seagrass beds and mangrove prop roots. Juvenile habitat preference was found to change with age, with the smallest juveniles (15-35mm CL) avoiding hard-bottom habitat in favor of loggerhead sponges, coral heads, and solution holes, while intermediate-sized juveniles (35-45mm CL) favored sponges and larger juveniles (+45mm CL) preferred hard-

bottom habitat (Bertlesen et al. 2009). Coleman et al. (2010) found red grouper holes to be important diurnal refugia for spiny lobster.

3. Determining possible new methods of designating EFH

Data used for EFH designation should use the best available data including peer-reviewed literature, unpublished scientific reports, government agency reports, and other sources of information. Habitat data should be organized to the four levels described in the EFH Rule (600.815(a)((1)(iii)(A)) and the highest levels of information available should be used.

In recent years the use of correlation-based statistical or machine-learning models that link habitat attributes with abundance or distribution patterns have increased rapidly in both scope and complexity and could aid in the identification of EFH. In the Gulf of Mexico, application of these new techniques could improve delineation of EFH and the environmental attributes that influence habitat quality for a variety of marine taxa (Knudby et al. 2010). Moreover, these techniques are based on environmental relationships thus may provide useful tools for evaluating future effects of management decisions or habitat alteration and could provide habitat-based, spatially explicit information for use in stock assessments of managed species.

Techniques employed for this purpose use a variety of statistical tools including conventional techniques (e.g., linear models, generalized linear models, generalized additive models), geostatistical (e.g., kriging, inverse distance weighted, natural neighbors, splines), and machine-learning techniques (e.g., support vector machine, ensemble regression tree methods). The Pacific Council in conjunction with the Pacific Groundfish Risk Assessment developed a Bayesian model that relates the likelihood of occurrence of a species or life stage to habitat characteristics (HEWG 2005). The types, performance, data requirements, and technical requirements necessary for these models vary widely, therefore identifying the most appropriate methodology a priori can be difficult or in some cases, impossible.

Substantial strides have been made with respect to modeling interactions in the marine environment. For example, regression tree analysis has been applied to marine fisheries (Pittman et al. 2007). This method has also been extended to include regression tree based boosting techniques (Elith et al. 2008) that may provide improved predictive capabilities and has recently been applied to fishes in the Gulf of Mexico (Froeschke et al. 2010). Knudby et al. (2010) reviewed several modern approaches to modeling fish-habitat relationships compared to these methods with a variety of other methods including GAM (the preferred methodology of the HEWG (2005)). Knudby et al. (2010) suggest that novel methods (e.g., boosted trees) may substantially improve predictions of fish distribution and abundance and that the tree-based ensemble techniques often exhibited lowest prediction error rates and identified fewer predictor variables than linear models or generalized additive models (GAM). Moreover, Knudby et al. (2010) suggest the potential to contribute to improved management and conservation using these techniques. The purpose of this section

was to explore the efficacy of employing the preferred techniques of the HEWG Report (Generalized Additive Models) and the Knudby et al. (2010) (tree-based ensemble techniques) for science-based essential fish habitat designation in the Gulf of Mexico.

4. Evaluating how species specific EFH identifications and descriptions can be better presented in addition to the FMP description

   The Council's EFH information should be updated as fishery management actions are developed for FMPs in the Gulf of Mexico. Specific actions to consider are: 1) SEAMAP plankton data can be used to designate and describe EFH for the early life history of managed species; 2) Additional HAPC designations can be considered; 3) EFH maps can be refined to species and life-stages and provide higher resolution of spatial EFH representation. Other methods for designating EFH can be explored over time with a possible refinement of EFH designations for applicable species and life stages.

5. Making recommendations on whether EFH descriptions should be updated

   The 2004 EFH EIS resulted from a court order to NMFS to complete a new and more thorough NEPA analysis of actions to minimize adverse effects of fishing on EFH. NMFS and the Councils decided the scope of the EIS should address all required EFH components of Section 303(a)(7) of the MSFCMA. This effort represents the first "periodic" review of EFH information solely for the purposes of satisfying Section 600.815(a)(10) of the EFH Final Rule.

   While the literature review provided new information on some managed species' habitat utilization, the new literature did not provide any information that would dramatically alter current EFH designations and descriptions.

6. Reviewing any changes and new information on fishing impacts that may adversely affect EFH

   A literature search of peer-reviewed literature, unpublished scientific reports, data files of government resource agencies, fisheries landing reports, and other sources of information was conducted to look for new published and unpublished scientific literature since the publication of the 2005 EFH Amendment. The fishing impacts on habitat literature review did not produce any new evidence or understanding on how current fisheries in the Gulf of Mexico are impacting habitat. Since the 2005 EFH Amendment, one potentially destructive gear, fish traps, has been banned in the Gulf of Mexico. Since 2000, fishing effort has declined for all fisheries and gears that were examined. Therefore, the alternatives that were developed in the 2005 EFH Amendment should still be adequate to protect EFH from fishing impacts.

7. Reviewing any changes and new information on non-fishing impacts that may adversely affect EFH

The review of non-fishing activities focused on Section 3.5.3 of the 2004 EFH EIS. That section of the EIS identifies non-fishing activities that have the potential to adversely impact EFH in order to support recommendations provided in accordance with the consultations requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Section 305(b)).

In February 2008, NOAA published Technical Memorandum NMFS-NE-209 entitled "Impacts to Marine Fisheries Habitat from Non-fishing Activities in the Northeastern United States". The report was the outcome of a technical workshop intended to assist the Northeast and Mid-Atlantic Fishery Management Councils in updating non-fishing impact analysis within their Fishery Management Plans. During the course of the workshop, it was recognized that the information being generated was applicable to a larger audience and the scope of the report was expanded. Although produced for the northeast United States, the comprehensive nature of the report provided a means to evaluate the 2004 EFH EIS analysis.

The following activities were analyzed in the Council's 2004 EFH EIS and conservation measures identified in the Council's original EFH Amendment (GMFMC 1998) to satisfy Section 600.815(a)(4) of the EFH guidelines:

- Navigation channels and boat access canals
- Docks and piers
- Boat ramps
- Marinas
- Cables, pipelines, and transmission lines
- Drainage canals and ditches
- Housing developments
- Bulkheads and seawalls
- Transportation
- Impoundments and other water level controls in wetlands
- Oil and gas exploration and production in coastal marsh, open bay, and OCS
- Other mineral mining/extraction
- Sewage treatment and disposal
- Steam-electric plants and other facilities requiring cooling or heating water
- Disposal of dredged material
- Water intakes and discharges
- Aquaculture/Mariculture

A review of the NOAA Technical Memorandum (NOAA 2008) identified information that could augment the analysis of several sections of the 2004 EFH EIS including:

1. Navigation channels: temporal impacts to water quality (e.g., turbidity) and benthic species composition; losses of submerged aquatic vegetation,

intertidal habitats and wetlands; impacts associated with different dredging methods
2. Docks and piers: impacts associated with vessels including mooring, grounding, prop-dredging, and wave-induced erosion; shading affects of floating structures, and water quality considerations of anti-fouling agents
3. Housing developments: alteration of local hydrodynamics including natural filtration of runoff, groundwater recharge, and floodwater retention
4. Bulkheads and seawalls: nearshore groins, jetties, and breakwaters
5. Offshore mineral mining for beach nourishment and other purposes
6. Municipal and industrial discharges
7. Non-point source discharges
8. Water intakes: impingement and entrainment of larval and juvenile life stages
9. Marine debris: abandoned and derelict vessels and intentional vessel disposal

NOAA (2008) also provides analysis of activities that have emerged and begun to emerge since the 2004 EFH EIS including liquid natural gas (LNG) facilities, offshore wind energy facilities, wave and current energy facilities, and climate change. While NOAA (2008) provides an analysis of mariculture and aquaculture activities, through their preparation of a Fishery Management Plan for offshore aquaculture the Gulf Council has completed a comprehensive analysis specific to the Gulf of Mexico.

While invasive plants and aquatic fish and invertebrates have presented problems in Gulf of Mexico estuaries, truly marine invasive fish have not been recorded. Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) are the first non-native marine fishes to establish themselves in the Western North Atlantic. Lionfish are long-finned reef-associated species that are widely distributed throughout the western Pacific. Lionfish were first confirmed in the United States in 1985 (Dania, FL) and since that period have rapidly spread in distribution and increased in abundance. Lionfish are now considered established off the Atlantic coast of the United States, Bermuda Island, the Bahamas, Turks and Caicos Islands, Cuba, Jamaica, Dominican Republic, Puerto Rico, Mexico, Honduras, and Costa Rica. Lionfish are present but not considered established in the US Virgin Islands, Gulf of Mexico, Belize, Panama, and Colombia and their range continues to expand. Reports have come from the Gulf of Mexico (Florida), Belize, Panamá and Colombia; although lionfish are not considered established in these localities as of August 2009 (Schofield 2009). However, specimens were collected during the 2010 SEAMAP 38 Summer Shrimp/Groundfish Survey in the Gulf of Mexico and invasions appear imminent in this region (Schofield 2009). Several lionfish were also sighted on artificial reefs off Alabama and Pensacola, Florida and on oil platforms off Louisiana in September 2010.

Lionfish inhabit reefs from 10 to about 175 m depth. Individuals are relatively inactive during the day, typically sheltering in reef crevices. The lionfish is a nocturnal species and moves to deeper waters at night to forage. The prey of the lionfish includes small fishes and crustaceans (Fishelson 1975; Harmelin-Vivien and Bouchon 1976), which are swept up and trapped with the extended pectoral fins. The

species is relatively quick to adapt to novel prey types, and quickly learns to avoid noxious prey (Fishelson 1997). An increase in piscivory occurs with age (Harmelin-Vivien and Bouchon 1976). The dorsal- and anal-fin spines of the lionfish contain potent venom and there are few known predators of these fishes in the Atlantic population.

In the U.S., the lionfish has rapidly increased in abundance and are now as abundant as many native grouper species in the Atlantic Ocean (Whitfield et al. 2007). It was thought the species' northward expansion along the Atlantic coast of the U.S. would be limited by cool water temperatures however, lionfish have been observed in water as cold as 56° F off the southern coast of Long Island.

8. Reviewing habitat areas of particular concern (HAPC) designations

The 2005 EFH Amendment identified several areas as HAPCs. Each proposed site is discrete, and meets one or more HAPC criteria:

1. Importance of ecological function provided by the habitat;
2. Extent to which the area or habitat is sensitive to human induced degradation;
3. Whether and to what extent development activities are stressing the habitat; and
4. Rarity of the habitat type.

HAPC were identified as the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and the individual reefs and banks of the Northwestern Gulf of Mexico: East and West Flower Garden Banks, Stetson Bank, Sonnier Bank, MacNeil, 29 Fathom Bank, Rankin Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Rezak Sidner Bank, Alderdice Bank, and Jakkula Bank.

Since the 2005 EFH Amendment, there have not been any directed studies to look at the effectiveness of the Council's HAPCs. The purpose of designating HAPCs was to help provide additional focus for conservation efforts for these areas. Some of these areas are already afforded protection through other means. The Madison-Swanson Marine Reserve is a marine protected area designated by the Council in 2000. Its designation as a marine protected area is designed to protect spawning aggregations of gag grouper and is closed to all fishing except for trolling for highly migratory species. The Tortugas North and South Ecological Reserve was 39 designated in 2001 and is closed to all fishing. East and West Flower Garden Banks and Stetson Bank are part of the Flower Garden Banks National Marine Sanctuary (FGBNMS).

While there have not been any directed studies to look at the effectiveness of protecting habitat in the areas designated as HAPCs, conversely there have not been any reports of habitat damage either. The HAPC designation has focused the Council's efforts in review of projects that may adversely affect these areas.

Marbled grouper, *Dermatolepis inermis*, are considered rare throughout their range. Marbled grouper have recently been listed as near threatened by the International Union for Conservation of Nature (IUCN). Not much is known about marbled grouper, but SEAMAP reef fish surveys have only shown the species to occur on a handful of banks in the northwestern Gulf of Mexico. Geyer Bank may be the only known area for spawning aggregations (Rocha et al. 2008). Geyer Bank is located approximately 200 km off the coast of Louisiana. In order to protect spawning aggregations of marbled grouper, a seasonal fishery closure around Geyer Bank may be warranted.