Revision timeline/process

Date	**Reviewer**
January 17, 2013	Meeting with James Morris, Carol Price, Ken Riley, Marc Turano, and Chris Elkins at NOAA/CCFHR. Decided to rewrite policy to bring up to date.
January 18, 2013	James Morris – Rewrote policy based on meeting notes and sent out for review.
January 18, 2013	Chris Elkins – Provided edits; James incorporated.
January 24, 2013	Carol Price – Provided edits; James incorporated.
February 12, 2013	Marc Turano – Provided edits; James incorporated.
March 21, 2013	Ken Riley – Provided edits, rewrote and added content to some sections, revised formatting: James incorporated.
March 26, 2013	New draft sent to Marc Turano, Chris Elkins, Carol Price (2nd review before outside review) with review deadline of April 5.
	Jess Beck (NMFS SE Region Aquaculture Coordinator)
	NOAA Office of Aquaculture (Rubi[illegible], Susan Bunsick, Brian Fredieu)
	To Chris Elkins to send to council staff

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POLICIES FOR THE INTERACTIONS BETWEEN ESSENTIAL FISH HABITATS AND MARINE AQUACULTURE (Draft April 2013)

Policy Context

This document establishes the policies of the South Atlantic Fishery Management Council (SAFMC) regarding interactions of marine aquaculture with Essential Fish Habitat (EFH) and Essential Fish Habitat - Habitat Areas of Particular Concern (EFH-HAPCs). The policies are consistent with the overall habitat protection policies of the SAFMC as formulated in the Habitat Plan (SAFMC 1998a) and adopted in the Comprehensive EFH Amendment (SAFMC 1998b) and the various Fishery Management Plans (FMPs) of the Council.

For the purposes of this policy, aquaculture is defined as the propagation and rearing of aquatic organisms for commercial, recreational, or public purposes. This definition covers all authorized production of finfish, shellfish, plants, algae, and other aquatic organisms for 1) food and other commercial products; 2) wild stock replenishment and enhancement for commercial and recreational fisheries; 3) rebuilding populations of threatened or endangered species under species recovery and conservation plans; and 4) restoration and conservation of aquatic habitat (DOC Aquaculture Policy 2011). This policy seeks to address concerns related to the production of seafood and other non-seafood related products (*e.g.*, biofuels, ornamentals, bait, pharmaceuticals, and gemstones) by aquaculture, but does not specifically address issues related to stock enhancement. The findings assess potential impacts, negative and positive, to EFH and EFH- HAPCs posed by activities related to marine aquaculture in offshore and coastal waters, riverine systems and adjacent wetland habitats, and the processes that could place those resources at risk. The policies and recommendations established in this document are designed to avoid and minimize impacts and optimize benefits from these activities, in accordance with the general habitat policies of the SAFMC as mandated by law. To address future marine aquaculture projects in the South Atlantic region, as legislation is developed to provide additional guidelines, and as knowledge gaps are filled, the SAFMC may revise this policy.

The recommendations presented apply to aquaculture activities that may impact EFH and EFH-HAPCs. Aquaculture activities have the potential to interact both positively and negatively with EFH and EFH-HAPCs when conducted in onshore, nearshore, and offshore environments. Current federal and state laws, regulations and policies differ for each of these environments and aquaculture activities in nearshore and onshore environments may fall under multiple jurisdictions. As the federal FMPs in the region are amended to address offshore aquaculture as "fishing" activities (GMFMC 2009, 2013), then these recommendations should be factored into those FMPs. Where aquaculture remains outside federal FMP-based management, then EFH protection mechanisms for "non-fishing" activities should be used to protect EFH, wherever possible. The reference to non-fishing activities is meant to clarify that the Council's role is to comment on aquaculture activities similar to process the Council uses for non-fishing activities. The MSA currently defines aquaculture as a fishing activity; however, the Council applies the same EFH standards to both fishing and non-fishing impacts.

Habitats and species possibly affected by marine aquaculture activities include many recognized in state-level fishery management plans and interstate fishery management plans of the ASMFC (see Appendices A & B). Examples of these habitats include state designated Critical Habitat Areas (CHAs) or Strategic Habitat Areas (SHAs) such as those established by the State Marine Fisheries Commissions, either in FMPs or in the coastal habitat protection or management plans.

<u>Overview of Marine Aquaculture and EFH Interactions</u>

The environmental effects of marine aquaculture can vary widely according to the species selected, location and scale of the aquaculture operation, the experience level of the operators, and the production methods utilized. Modern production technologies, proper siting, standardized operating procedures, and best management practices reduce the risk of environmental degradation from aquaculture activities. In recent years, marine aquaculture has been used to bolster EFH and in some instances, aquaculture has been used to mitigate eutrophication using practices that sequester nutrients in coastal waters (*e.g.*, shellfish and algae culture). The following summarizes the types of environmental effects that have been documented and the best management practices and other existing regulatory frameworks for safeguarding coastal resources. This summary is not an exhaustive literature review of scientific information on this complex topic. It is a synthesis of relevant information intended to provide managers with a better understanding of environmental interactions with marine aquaculture. It should be noted that environmental impacts from intensive operations that culture finfish can vary dramatically from those associated with molluscan shellfish operations because of the sessile nature of shellfish, lack of feed inputs, and the trophic level of the organism being cultured.

The SAFMC recognizes the following potential interactions between marine aquaculture and EFH:

Escapement

Ecological damage caused by escaped, or displaced (in the case of shellfish), organisms from aquaculture is well-documented in riverine, estuarine, and marine habitats (Waples et al. 2012). Escapees can disrupt important ecosystem processes, compete for resources, transmit diseases and parasites to wild fish, and breed or interbreed with wild populations. While the environmental impact is measurable, extensive research has shown that farmed or domesticated species are competitively inferior to wild populations and are less fit in the wild (Glover et al. 2012). The potential adverse impacts on EFH include: (1) habitat alteration, (2) trophic alteration, (3) gene pool alteration, (4) spatial alteration, (5) introduction of diseases, and (6) introduction of invasive species. The likelihood of escapes from farms is variable depending on species under culture, siting guidelines, farm design, management practices including probability for human error, frequency of extreme weather events, and direct interactions with predators such as sharks, marine mammals, and birds. While a certain level of escapes probably cannot be avoided, particularly when production is scaled to optimize economic sustainability and business performance, risk assessments should be used to make informed regulatory decisions and account for potential impacts to natural populations.

Genetic introgression of farmed escapees in wild populations is strongly density-dependent and appears linked to the health of native populations. To make a genetic impact, escapes must survive and reproduce successfully in the wild. The capability of escaped fish to do this can vary widely based on many environmental and biological factors. In general, fitness in the wild of captive-reared individuals decreases with domestication or the number of generations in captivity. Some genetic risks are inversely correlated, such that reducing one risk simultaneously increases another. For example, creating a genetically divergent aquaculture population might reduce the chances that escapes can survive and reproduce, but those that do can pass on maladapted genes to the natural population. An effective monitoring component is important, but cannot compensate for failure to implement risk-aversion strategies. Even ambitious monitoring programs might have low power or probability to detect adverse effects before serious harm is caused to the environment.

Risk assessment strategies should be evaluated during planning an operation. Good practices for monitoring, inspections, and maintenance of the farm is critical to prevent escapes. In the case of non-native organisms, states are encouraged to use caution when permitting the culture of non-native species, both onshore and offshore. Non-native species can cause substantial impacts to EFH and robust biosecurity plans are needed to prevent introductions.

Spread of pathogens

The spread of pathogens from aquaculture operations is among the prominent threats to fisheries and EFH conservation. Once a pathogen or disease agent is introduced and becomes established in the natural environment, there is little or no possibility for either treatment or eradication. The aquaculture industry has been overwhelmed with its share of diseases and problems caused by viruses, bacteria, fungi, parasites, and other undiagnosed and emerging pathogens. The current trend in aquaculture development towards increased intensification and commercialization will undoubtedly lead to increased risk for disease transfer or introduction. The concentration of large numbers of animals in a small area can facilitate outbreaks of disease, potentially jeopardizing wild stocks. The prevalence of disease in intensive aquaculture operations is influenced by many factors, including immune status, level of stress, pathogen load, environmental conditions, nutritional background, and feeding management, as well as the level of husbandry and disease surveillance practices.

Industry expansion and diversification has resulted in well-documented parasite translocations with movement of cultured fish and shellfish species (Bondad-Reantaso et al. 2005). In many countries and regions, compacts and agreements have established guidelines for screening and certification programs for movement of germplasm, embryos, larvae, juveniles, and broodstock. In the U.S., import and export certifications and testing for certain types of diseases should be performed by a licensed veterinarian working with an aquatic animal health laboratory approved by the USDA Animal Plant and Heal Inspection Service (APHIS).

Climatic change has been implicated in the prevalence and severity of infectious diseases originating from cultured or transplanted aquaculture stocks (Hoegu-Guldberg and Bruno 2010). The emergence of these diseases is likely a consequence of several factors, including expansion of pathogen ranges in response to warming, changes to host susceptibility as a result of increasing environmental stress, and the expansion of potential vectors. Classical examples are outbreaks of oysters infected with MSX (*Haplosporidium nelsoni*), Dermo (*Perkinsus marinus*), and Bonamia spp. (Ford and Smolowitz 2007, Soniat et al. 2009, Shumway 2011). In most cases, introduced pathogens have undergone rapid ecological and genetic adaptation in response to climate change. Guidelines for management of these diseases are well-developed for shellfish and other aquatic species. Managing for disease outbreaks is a key aspect of climate adaptation to prevent adverse impact to EFH. Management guidelines include record keeping and strict regulations on stocking or transplanting species from infected areas. Following these management recommendations should yield protection and conservation benefits for EFH.

Use of drugs, biologics, and other chemicals

All aquaculture operations will have demand for drugs, biologics, and other chemicals. This may include: (1) disinfectants as part of biosecurity protocols, (2) herbicides and pesticides used in pond maintenance, (3) spawning aids, (4) vaccines used in disease prevention, or (5) marking agents used in resource management (AFS 2011). Despite the best efforts of aquaculture producers to avoid pathogen introductions, therapeutic drugs are occasionally needed to control mortality, infestations, or infections. In contrast to other agricultural enterprises, the availability and use of approved pharmaceutical drugs, biologics and other chemicals is quite limited for marine aquaculture (FDA 2012).

Record-keeping is essential for any aquaculture business, and the use of regulated products requires it. Detailed records provide a basis for sound, cost-effective management decisions. A good record-keeping system helps producers keep track of specific treatments and their results with identifiable, known populations or stocks of aquatic animals, as well as the specific water and land areas involved. By implementing good record-keeping practices, the status of all animals and culture systems can be determined at any time by all personnel or regulatory authorities.

In finfish aquaculture, modern farm management practices including adjustment of stocking densities and timing of stocking are now being used to avoid parasite outbreaks. While antibiotics are the most commonly cited chemical therapeutic, the use of antibiotics in aquaculture has declined greatly in recent years – by 90% in salmon culture (Tveterås 2002). Antibiotics from fish feed can pass directly into marine organisms foraging on excess feed or accumulate in the sediments. Laboratory and field studies have found that antibiotic persistence in sediment ranges from a few days to years depending on the drug in question and the geophysical properties (including light level, oxygen levels, pH, temperature, and sediment type) of the water or sediment (Scott 2004, Armstrong et al. 2005, Rigos and Troisi 2005b). This provides the opportunity for antibiotic-resistant bacteria, including pathogens, to emerge around or downstream from fish farms. At present, there are no approved antibiotics for use with marine aquatic species in the South Atlantic. A limited number of broad spectrum antibiotics and feed additives (*i.e.*, florfenicol and oxytetracycline) are allowed as part of the National Investigational New Animal Drug Program as permitted by the U.S. Fish and Wildlife Service.

Antibiotics should be used sparingly and in accordance with approved protocol to minimize accumulation and significant ecological impacts. Vaccination, improvements in fish husbandry, and other best management practices are proven alternatives for maintaining fish health, and product quality and safety. A list of FDA approved drugs for use in marine aquaculture is provided in Appendix C.

Water quality impacts

Finfish and shrimp culture operations use substantial amounts of feeds. As such, some form of nutrients (nitrogen and phosphorus) eventually leave the operation either directly as excess feed, or indirectly as a by-product of fish waste. Nutrient spikes and associated phytoplankton production can lead to fluctuations in dissolved oxygen, although these impacts vary by location (*i.e.*, on-shore, near-shore, and offshore) with operations near well-flushed areas having reduced impacts. Water quality impacts also vary by production type, with closed systems located onshore are able to control discharge better than those located offshore.

The impacts of nutrients discharged from near-shore aquaculture operations can oftentimes be confounded by the occurrence of many anthropogenically derived nutrients in coastal marine waters, making it difficult to attribute eutrophication to any one source, including aquaculture. Water quality impairments from aquaculture operations can be minimized through the development of best management practices to include careful feed management strategies, use of optimally formulated diets and management to minimize nutrient discharge, regardless of location.

Benthic sediment and community impacts

Particulate waste (primarily in the form of organic carbon) can also be discharged from finfish and shellfish operations. For finfish operations, particulate waste originates from feed inputs, whereas some shellfish operations release pseudofeces, a byproduct of filtering water. In excess, these wastes can alter the bottom sediment and associated flora/fauna. Common indicators used to assess benthic condition include total organic carbon, redox potential, total sulfides, and abundance and diversity of marine life.

Electro-chemical and image analysis methods now aid in assessing benthic health. At poorly sited or managed farms, bottom areas can become overloaded with organic sediment that does not decompose quickly by natural aerobic bacterial processes. The sediment will shift toward anaerobic conditions, and the benthic community will reflect a decline in species diversity with only a few generalists and perturbation tolerant species. Benthic accumulation of farm discharges can be reduced by siting operations near areas of high flushing, or where net erosional sediments can decrease or eliminate accumulation of wastes and minimizes benthic effects. In some cases, moderate farm discharge has been shown to enhance local productivity of marine species including algae and fish. Monitoring plans should be designed to allow for early detection of benthic enrichment and deterioration of benthic community structure. Management requires good data about nearby control sites to differentiate between farm effects and natural and seasonal variability, or non-farm factors.

<u>Coastal pelagics and reduction fisheries for fishmeal and feed additives</u>

The development and expansion of aquaculture of carnivorous fish, shrimp, and other aquatic species may soon be constrained by a limited supply of fish meal and fish oil for feeds. Fish meal and fish oil traditionally have made up a large part of the diet of cultured fish and shrimp. These feed ingredients are volatile commodities traded worldwide. While the U.S. is the world's largest and most advanced producer of commercially formulated animal diets, our country is a small player in the global market for fish meal and fish oil with little control over prices or quantities sold.

Fish meal and fish oil are important components in aquaculture feeds because they supply nutrients such as essential amino acids, vitamins, minerals, and fatty acids. There is no dietary requirement for fish meal or fish oil for any aquatic organism and there are alternative sources for high quality feed ingredients. The production of fish meal and fish oil has been relatively constant for the past 20 years, but in recent years, the percentage consumed by aquaculture has risen, now accounting for 60 to 70 percent of the annual production of fish meal and 80 to 90 percent of the annual production of fish oil (Rust et al. 2012). While virtually any fish or shellfish harvested can be used to make fish meal and fish oil, these products are largely made from small pelagic or reduction fisheries such as anchovies, menhaden, and sardines. The majority of fishmeal produced in the U.S. comes from menhaden, caught in the Gulf of Mexico and Atlantic Ocean. Reduction fisheries targeted for fish meal and oil production are well regulated under strict management plans [illegible] by federal law and are not overfished.

There is growing concern that intensive aquaculture, especially carnivorous marine species of fish and shrimp, will lead to an increased fishing pressure on wild stocks due to increased demand for fishmeal. Many coastal pelagic species harvested for reduction fisheries constitute a threat to EFH because they are a major prey species for several managed stocks. Actions that reduce the availability of major prey species (*i.e.*, Atlantic menhaden) may be considered adverse effects on EFH if such actions reduce the quality of EFH. The National Marine Fisheries Service (2006) provided the Councils with the following guidance on implementing the Prey Species Requirement of the EFH Final Rule as follows:

The definition of EFH in the regulatory guidelines acknowledge that prey, as part of "associated biological communities", may be considered a component of EFH for a species and/or lifestage (50 CFR 600.10). However, including prey in EFH identifications and descriptions has considerable implications for the overall scope of EFH when those prey are considered during the EFH consultation process. It is important that prey do not become a vehicle for overly expansive interpretations of EFH descriptions. To avoid this pitfall, the following suggestions should be considered when including prey in an EFH description:

1. Prey species alone should not be described as EFH. Instead, prey should be included in EFH descriptions as a component of EFH (along with others components such as location, depth, temperature, and sediment type).

2. If the FMP identifies prey as a component of EFH, the FMP should specify those prey species and how their presence "makes the waters and substrate function as feeding habitat" (50 CFR 600.815(a)(7)).

The dramatic increase in demand for fish meal and fish oil (Tacon and Metian 2008) coupled with the apparent plateau in reduction fisheries landings (Pauly et al. 2002) has led to significant research into plant-based alternatives to fish meal and fish oil as ingredients in aquaculture feeds. To address this need, NOAA and USDA have developed an alternative feeds initiative to accelerate the use of alternative dietary ingredients that will allow the global aquaculture industry to grow without putting unsustainable pressure on commercial fisheries.

Location Specific Interactions with EFH

Onshore Aquaculture

Onshore aquaculture is defined as ponds, raceways, and tank-based aquaculture systems that are used for multiple phases of aquaculture including broodstock holding, hatchery production, nursery production, growout, and quarantine. Aquaculture systems range from extensive, through semi-intensive and highly intensive to hyper-intensive. Water demand and usage varies from conventional pond systems to advanced recirculating aquaculture systems with sophisticated filtration components for water reuse. Onshore marine aquaculture operations have the potential to impact a variety of EFHs including:

a) waters and benthic habitats in or near marine aquaculture sites;
b) exposed hardbottom (i.e., reefs and live bottom) in shallow and deep waters;
c) submerged aquatic vegetation beds;
d) shellfish beds;
e) spawning and nursery areas;
f) coastal wetlands, and
g) riverine systems and associated wetlands.

The greatest impacts to EFH by onshore aquaculture involve escape of invasive species and nutrient discharge and its impact on water quality and bottom sediments. Onshore aquaculture activities affecting EFH are regulated by existing state and federal laws such as the EPA National Pollutant Discharge Elimination System (NPDES) and coastal habitat protection plans.

Nearshore Aquaculture

Nearshore aquaculture activities are defined as aquaculture activities that occur in rivers, sounds, and estuaries and coastal ocean (such as inlets or nearshore ocean habitats that are not considered open ocean). Currently in the South Atlantic region, nearshore aquaculture is characterized primarily as shellfish aquaculture with hard clams *Mercenaria mercenaria* and oysters

Crassostrea virginica comprising the most commonly cultured species.

While the relative threat of nearshore shellfish aquaculture to various EFHs is uncertain, the ranges of possible interactions include:

a) coral, coral reef and live/hardbottom habitat, including deepwater coral communities;
b) marine and estuarine waters;
c) estuarine wetlands, including mangroves and marshes;
d) submerged aquatic vegetation;
e) waters that support diadromous fishes, and their spawning and nursery habitats, and
f) waters hydrologically and ecologically connected to waters that support EFH.

The primary interactions of nearshore aquaculture with EFH are changes to benthic habitat as a result of pseudofeces and the potential for mechanical harvesting impacts on EFH. These include conversion of soft sediment habitat to hard bottom shellfish reef, displacement of cultured organisms, potential genetic transfer, sedimentation and loading of organic wastes to the water column and benthic sediments, and disruption of the benthic community. Some changes could potentially impact SAV located near aquaculture operations, although this impact likely varies with species and production type.

In general, shellfish aquaculture has positive impacts on EFH, providing ecosystem services and habitat related benefits in the estuary including mitigation of land-based nutrients and increased habitat for fish, shellfish, and crustaceans (Shumway [illegible]). States are encouraged to carefully consider the positive and negative effects of shellfish culture activities to EFH when considering permitting guidelines. The risk of nearshore aquaculture impacts to EFH is minimized by existing state and federal laws and regulations such as the Army Corps of Engineers National Permit 48, which provides protection for sensitive habitats from shellfish aquaculture activities. Best management practices are now in place for shellfish aquaculture along the U.S. East Coast (Flimlin 2010).

Offshore Aquaculture
Offshore aquaculture activities occur in marine waters of the coastal ocean. In the South Atlantic region, offshore aquaculture may include the cultivation of macrophytic algae, molluscan shellfish, shrimp, or finfish. While there are no current offshore aquaculture activities occurring in the South Atlantic region, it is feasible that co-siting with other offshore industries such as oil, gas, or wind energy may facilitate aquaculture development.

While the relative threat of offshore aquaculture to EFHs varies widely depending on siting and farm management considerations, the ranges of possible interactions include:

a) coral, coral reef and live/hardbottom habitat, including deepwater coral communities;
b) marine and estuarine waters;
c) submerged aquatic vegetation;
d) waters that support diadromous fishes, and their spawning and nursery habitats, and
e) waters hydrologically and ecologically connected to waters that support EFH.

The environmental effects of shellfish and finfish aquaculture in the coastal ocean are well-documented (Naylor et al. 2006; Nash 2005; Price and Morris 2013; Shumway 2011). Poorly sited and managed aquaculture activities can have significant impact on benthic communities, water quality, and marine life. While there are many case studies documenting environmental impacts dating back several decades, recent regulatory and management practices are reducing the likelihood of negative environmental effects.

In the case of offshore fish cage culture, water quality and benthic effects are sometimes observed; however, these are typically episodic and restricted to within 30 m of the cages. There is unlikely to be long-term risk to water quality from marine aquaculture when farms are sited in well-flushed waters. Belle and Nash (2008) recommend the siting of fish cages in water at least twice as deep as the cage with minimum flows of 7cm/sec. Algal blooms are not expected to result from nutrient enrichment from fish aquaculture. It is not common for increases in chlorophyll or algal production to be measureable near fish farms, especially in well flushed areas.

Moderate nutrient loads discharged from fish farms can increase productivity of some marine environments. This is especially true in waters with naturally low levels of nitrogen and phosphorus, where nutrients are quickly assimilated into the food web. This is difficult to study due to the rate that nutrients are flushed away and then absorbed remotely by phytoplankton.

The most studied benefit from marine aquaculture operations is as fish attractants because wild fish use the cages for foraging on biofouling organisms, uneaten feed and for shelter. Wild fish can help distribute organic waste away from the cages and help re-suspend organic compounds in sediments. Overall fish abundance may increase in areas with well-established fish farming operations. Resulting interactions with recreational or commercial fishers and marine mammals that are attracted to the forage fish around cages are identified as potential long-term concern.

Over twenty-five laws exist to provide regulatory oversight of aquaculture in federal waters. Some examples include the Clean Water Act and the Coastal Zone Management Act. Best management practices for marine cage culture are being developed for the U.S. Caribbean.

Live Rock Aquaculture

Live rock is described as living marine organisms or an assemblage thereof attached to a hard calcareous substrate. The SAFMC established a live rock aquaculture permit and management system under Amendment 3 to the Coral FMP (1995). The permit system allows management of live rock aquaculture operations while maximizing protection of bottom habitat, EFH, and HAPC in the South Atlantic EEZ. The Council received extensive input on live rock aquaculture during development of Amendment 3. At present, there are 11 active permits and 6 inactive permits in the South Atlantic issued to 17 different entities. All sites are in the Florida Keys.

Management tools

Fallowing is the practice of relocating marine fish cages to allow the sediment below to undergo natural recovery, both geochemically and ecologically, from the impacts of nutrient loading. At depositional sites where organic waste tends to accumulate, fallowing is a common practice to allow chemical and biological recovery of benthic sediments (Wildish and Pohle 2005, Halwart et al. 2007, Tucker and Hargreaves 2008, Borg and Massa 2011). This management tool is widely recommended and implemented around the world to prevent long-term benthic degradation. Fallowing times range from a few months to several years depending on the site's flushing characteristics and level of accumulation (Brooks et al. 2003, Brooks et al. 2004, Lin and Bailey-Brock 2008). Ideally, farms would be managed in equilibrium with the abilityof the marine environment to assimilate nutrients, thus eliminating the need for fallowing altogether.

Integrated multi-trophic aquaculture, or IMTA, is the practice of culturing finfish in combination with other species that filter waste particulates and dissolved nutrients, thereby reducing environmental discharge and expanding the economic base of a farming operation (Chopin 2006). The IMTA approach strives for a more balanced culturing system to emulate natural nutrient cycling processes. Though currently considered experimental in the U.S., IMTA is being applied in other countries to absorb nutrients (primarily nitrogen and phosphorus) that would otherwise be discharged into the environment. The most common species for IMTA include edible seaweeds and shellfish like oysters or mussels, but other invertebrate species including lobsters and sea cucumbers are also good IMTA candidates.

SAFMC Policies for Marine Aquaculture

The SAFMC establishes the following general policies related to marine aquaculture projects, to clarify and augment the general policies already adopted in the Habitat Plan and Comprehensive Habitat Amendment (SAFMC 1998a; SAFMC 1998b):

1. The Council strongly supports thorough public review and effective regulation of marine aquaculture activities in the South Atlantic EEZ. South Atlantic fisheries are dependent upon healthy habitat already impacted from many anthropogenic activities sources, so marine aquaculture must be ecologically as well as economically sustainable.

2. Permits should be for at least a ten-year duration with annual reporting requirements (activity reports) and a five-year comprehensive operational review with the option for revocation at any time in the event there is no prolonged activity or there are documented adverse impacts to marine resources (run on sentence). Given the changes underway in coastal ecosystems in response to storm events, rising seas and introduced species, such a review cycle is essential.

3. The Council approves use of drugs, biologics, and other chemicals approved by the FDA, EPA, USDA, or USFWS specifically for use in offshore open water or net pen aquaculture.

4. The use of non-native species should be prohibited in offshore environments. The use of genetically modified organisms is a highly controversial debate and should be considered as a separate issue and pending approval by FDA.

5. Given the critical nature of proper siting, the applicant should provide all needed information to evaluate in full the suitability of potential sites. If sufficient information is not provided in the application review time allotted by existing processes, the permit should be denied or held in abeyance until required information is available.

6. Monitoring plans should be developed by the applicant/permit holder and approved by NOAA Fisheries with input from the Council. Monitoring plans should be reviewed, approved, and funded prior to implementation.

7. Permittees must have adequate resources legally committed to ensure proper decommissioning of obsolete or storm-damaged facilities.

8. The issuing agency should have clear authority to repeal or condition permits in order to prevent environmental damage and exercise its authority to repeal permits if it becomes evident that environmental damage is occurring or if permit conditions are not met.

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Appendix A.

List of Potentially Affected Species and their EFH in the South Atlantic

Sections of South Atlantic waters potentially affected by these projects, both individually and collectively, have been identified as EFH or EFH-HAPC by the SAFMC. Potentially affected species and their EFH under federal management include (SAFMC, 1998b):

a) Summer flounder (various nearshore waters; certain offshore waters);
b) Bluefish (various nearshore waters);
c) Red drum (unconsolidated bottoms in the nearshore);
d) Many snapper and grouper species (live hardbottom from shore to 600 feet, and – for estuarine-dependent species (*e.g.*, gag grouper and gray snapper) – unconsolidated bottoms and live hardbottoms to the 100 foot contour);
e) Black sea bass (various nearshore waters, including unconsolidated bottom and live hardbottom to 100 feet, and hardbottoms to 600 feet);
f) Penaeid shrimp (offshore habitats used for spawning and growth to maturity, and waters connecting to inshore nursery areas);
g) Coastal migratory pelagics (*e.g.*, king mackerel, Spanish mackerel; sandy shoals of capes and bars, barrier island ocean-side waters from the surf zone to the shelf break inshore of the Gulf Stream);
h) Corals of various types and associated organisms (on hard substrates in shallow, mid-shelf, and deep water);
i) Muddy, silt bottoms from the subtidal to the shelf break, deep water corals and associated communities;
j) Areas identified as EFH for Highly Migratory Species managed by the Secretary of Commerce (*e.g.*, for sharks this includes inlets and nearshore waters, including pupping and nursery grounds), and
k) Federal or state protected species.

Appendix B.

<u>List of Potentially Affected Habitats</u>

Many of the habitats potentially affected by these activities have been identified as EFH- HAPCs by the SAFMC. Each habitat and FMP is provided as follows:

a) All hardbottom areas (SAFMC snapper grouper);
b) Nearshore spawning and nursery sites (SAFMC penaeid shrimps and red drum);
c) Benthic Sargassum (SAFMC snapper grouper);
d) From shore to the ends of the sandy shoals of Cape Lookout, Cape Fear, and Cape Hatteras, North Carolina; Hurl Rocks, South Carolina; and Phragmatopoma (worm reefs) reefs off the central coast of Florida and near shore hardbottom south of Cape Canaveral (SAFMC coastal migratory pelagics);
e) Hurl Rocks (South Carolina); the Phragmatopoma (worm reefs) off central east coast of Florida; nearshore (0-4 meters; 0-12 feet) hardbottom off the east coast of Florida from Cape Canaveral to Broward County; offshore (5-30 meters; 15-90 feet) hardbottom off the east coast of Florida from Palm Beach County to Fowey Rocks; Biscayne Bay, Florida; Biscayne National Park, Florida; and the Florida Keys National Marine Sanctuary (SAFMC coral, coral reefs and live hardbottom Habitat);
f) EFH-HAPCs designated for HMS species (e.g., sharks) in the South Atlantic region (NMFS Highly Migratory Species);
g) Oculina Bank HAPC and proposed deepwater coral HAPCs (SAFMC coral, coral reefs, and live hardbottom habitat), and
h) HAPCs for diadromous species adopted by the Atlantic States Marine Fisheries Commission (ASMFC).

Appendix C.
Use of Drugs, Biologics, and Other Chemicals

Several federal agencies are involved in regulating drugs, biologics, and chemicals used in aquaculture. Each federal agency has specific, congressionally mandated responsibilities to regulate the products under their jurisdictions. In the case of aquaculture, there is some overlap between these federal agencies, as well as with state and local regulatory bodies.

The U.S. Food and Drug Administration (FDA) regulates the use of animal drugs and animal feed in aquaculture, ensuring their safety and efficacy. The FDA is responsible for ensuring that drugs used in food-producing animals, including cultured seafood, are safe and effective and that foods derived from treated animals are free from potentially harmful drug residues.

The EPA is tasked with regulating disinfectants, sanitizers, and aquatic treatments used solely for control of algae, bacterial slime, or pest control (excluding pathogens in or on fish). As authorized by the Clean Water Act, EPA also administers NPDES permits, which regulates discharge of pollutants that include drugs and chemicals from aquaculture operations into U.S. waters.

The USDA Animal and Plant Health Inspection Service (APHIS) regulates all veterinary biologics, including vaccines, bacterins, antisera, diagnostic kits and other products of biological origin. APHIS is responsible for testing, licensing, and monitoring of vaccines used in aquaculture. They insure that all veterinary biologics used for diagnosis, prevention, and treatment of aquatic diseases are pure, safe, potent, and effective.

The Federal Food, Drug, and Cosmetic Act (FFDCA) defines the term “drug” broadly to include articles intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease. In aquaculture, this includes compounds such as antibiotics, sedatives and anesthetics, and gender manipulators and spawning aids. Common household compounds are also considered drugs (*e.g.*, hydrogen peroxide, salt, ice). These products cannot be used on aquatic species unless they have been approved by FDA for the intended purpose.

- Disinfectants are compounds, which have antimicrobial properties that are generally applied to equipment and structures and are not intended to have a therapeutic effect on cultured animals.
- Pesticides are not widely used in aquaculture; however, herbicides can be an important part of aquatic weed management in pond production.
- Biologics include a range of products of biologic origin used in the diagnosis, prevention, and treatment of diseases. In aquaculture, the most commonly used biologics are vaccines used to immunize animals and prevent infections from occurring.

All drugs used to control mortality associated with bacterial diseases or infestation density of parasites, sedate or anesthetize fish, induce spawning, change gender, or in any other way change the structure or function of aquatic species must be approved by the FDA. It is illegal to use (1) unapproved drugs for any purpose or (2) approved drugs in a manner other than that specified on the product label unless the drugs are being used under the strict conditions of an investigational new animal drug (INAD) exemption or an extra-label prescription issued by a licensed veterinarian. Some aquaculture producers may use drugs that are not approved for aquaculture, but considered to be of low regulatory priority (LRP) enforcement, examples include acetic acid, carbon dioxide, sodium bicarbonate, sodium chloride, and ice.

For more information visit:

1. **US FDA Animal and Veterinary Drugs for Aquaculture**

http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/Aquaculture/ucm132954.htm

2. **A Quick Reference Guide to: Approved Drugs for Use in Aquaculture**

http://www.fda.gov/downloads/AnimalVeterinary/ResourcesforYou/AnimalHealthLiteracy/UCM109808.pdf

3. **Guide to Using Drugs, Biologics, and Other Chemicals in Aquaculture**

http://www.fws.gov/fisheries/aadap/AFS-FCS%20documents/GUIDE_OCT_2011.pdf

Table 1. Approved and conditionally approved drugs for use in marine aquaculture.

Active Ingredient	Tradename	Indication(s)
Chorionic gonadotropin	Chorulon®	Aid to improve spawning function in broodstock
Formalin	Parasite-S®, Formalin-F®, Formacide-B®, Paracide-F®	Control of fungi and external parasites in all finfish and penaeid shrimp
Oxytetracycline hydrochloride	Pennox® 343, Tetroxy®	Mark skeletal tissues for tagging finfish
Oxytetracycline dihydrate	Terramycin® 200	Broad spectrum antibiotic to control ulcer disease, furunculosis, bacterial hemorrhagic septicemia, enteric redmouth, pseudomonas disease, and other gram negative systemic bacteria in marine fish, Mark skeletal tissues for tagging finfish
Tricaine methanesulfonate	Finquel®, Tricaine-S®	Anesthesia and immobilization of finfish and other aquatic poikilotherms

Table 2. Low regulatory priority aquaculture drugs for use in marine aquaculture.

Active Ingredient	Indication(s)
Acetic acid	Parasiticide for finfish
Calcium chloride	Used to aid in egg hardening, Used to aid in maintaining osmotic balance during holding and transport of aquatic animals
Calcium oxide	External protozoacide for finfish
Carbon dioxide gas	Anesthesia and immobilization of finfish and other aquatic poikilotherms
Fuller's Earth	Use to reduce the adhesiveness of fish eggs
Garlic (whole form)	Use to control heminth and sea lice infestations of marine finfish
Ice	Use to reduce the metabolic rate of aquatic poikilotherms during transport
Magnesium sufate	Used to treat external parasites (monogenic trematodes and crustaceans) in finfish
Onion (whole form)	Used to treat external parasites (sea lice and other crustaceans) in finfish
Papain	Used to reduce the adhesiveness of fish eggs
Potassium chloride	Used to aid in maintaining osmotic balance during holding and transport of aquatic animals
Providone iodine	Used to disinfect fish eggs
Sodium bicarbonate	Used to introduce carbon dioxide into water for anesthetizing aquatic animals
Sodium chloride (salt)	Used to aid in maintaining osmotic balance during holding and transport of aquatic animals; Parasiticide for aquatic animals
Sodium sulfite	Used to reduce the adhesiveness of fish eggs
Thiamine hydrochloride	Used to prevent or treat thiamine deficeincy in finfish
Urea and tannic acid	Used to reduce the adhesiveness of fish eggs

Table 3. Investigational new animal drug exemptions for use in marine aquaculture. Permits held by the U.S. Fish and Wildlife Service as part of the National INAD Program.

Active Ingredient	Tradename	Indication(s)
Common carp pituitary	-	Aid to improve spawning function in broodstock
Catfish pituitary	-	Aid to improve spawning function in broodstock
Chloromine-T	Halamid®, Actamide®	Control of bacterial gill disease and external flavobacteriosis in certain species of marine finfish
Florfenicol	Aquaflor®	Broad spectrum antibiotic to control ulcer disease, furunculosis, bacterial hemorrhagic septicemia, and pseudomonas disease in marine aquatic animals
Hydrogen peroxide	Perox-Aid®	Use to treat external parasites in marine finfish
Luteinizing hormone releasing hormone analogue (LHRHa)	-	Aid to improve spawning function in broodstock
Oxytetracycline hydrochloride	Pennox® 343	Broad spectrum antibiotic to control ulcer disease, furunculosis, bacterial hemorrhagic septicemia, enteric redmouth, pseudomonas disease, and other gram negative systemic bacteria in marine fish, Mark skeletal tissues for tagging finfish
Oxytetracycline dihydrate	Terramycin® 200	Broad spectrum antibiotic to control ulcer disease, furunculosis, bacterial hemorrhagic septicemia, enteric redmouth, pseudomonas disease, and other gram negative systemic bacteria in marine fish, Mark skeletal tissues for tagging finfish
Calcein	Se-Mark®	Mark skeletal tissues for tagging finfish

Table 3 continued. Investigational new animal drug exemptions for use in marine aquaculture. Permits held by the U.S. Fish and Wildlife Service as part of the National INAD Program.

Active Ingredient	Tradename	Indication(s)
Salmon ganadotropin releasing hormone analogue (sGnRHa)	Ovaprim®, Ovaplant®	Aid to improve spawning function in broodstock
Benzocaine	Benzoak®	Anesthesia and immobilization of finfish and other aquatic poikilotherms
Eugenol	Aqui-S® 20E	Anesthesia and immobilization of finfish and other aquatic poikilotherms
Emamectin benzoate	Slice®	Use to control sea lice and other external parasite infestations of marine finfish
Methyl testosterone	-	Use to produce populations comprising over 90% phenotypically male finfish

Appendix D.

Examples of existing laws to minimize environmental risks associated with marine aquaculture.

Coastal Zone Management Act
Endangered Species Act
Rivers and Harbors Act of 1899
Clean Water Act
National Marine Sanctuaries Act
National Invasive Species Act
National Aquaculture Act
Outer Continental Shelf Lands Act
National Sea Grant College and Program Act
Fish and Wildlife Coordination Act
E.O. 11987: Exotic Organisms
E.O. 12630: Takings
E.O. 13089: Coral Reef Protection
E.O. 13112: Invasive Species
E.O. 13158: Marine Protected Areas
Marine Mammal Protection Act
Magnuson-Stevens Fishery Conservation and Management Act
Animal Health Act of 2002