

Management Considerations for the Southeast Florida Coral Reef Ecosystem

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1 Executive Summary

The purpose of this document is to convey information to stakeholders regarding Florida's coral reef and reef ecosystem components, describe existing state and federal management frameworks and illustrate a number of management approaches for use in developing a stakeholder-driven management planning process appropriate for southeast Florida.

The need for management of coral reefs in Florida was first recognized in the Florida Keys over 50 years ago and is only recently being expanded to the entire Florida Reef Tract. John Pennekamp Coral Reef State Park was established in 1960 to address the need for protection of coral reefs from degradation. The Florida Keys National Marine Sanctuary (FKNMS) was designated to protect more of the Florida coral reef ecosystem, including associated seagrass and mangrove habitats, on the southern 2/3 of the Florida Reef Tract. A recent addition to the FKNMS includes the Tortugas Ecological Reserve, which protects a number of marine habitats that are important to recreationally and commercially harvested reef fish species. Approximately 2,900 square miles of coral reef and other important marine habitats are currently under coordinated management (with the state and federal agencies sharing management responsibilities). Biscayne National Park (BNP), in southern Miami-Dade County, consists of four primary ecosystems: a narrow fringe of mangrove forest along the mainland shoreline; the southern expanse of Biscayne Bay; the northernmost islands of the Florida Keys; and a portion of the third-largest coral reef in the world. BNP is 95% water; therefore the majority of animal life is associated with ocean or shoreline habitats.

Unlike the FKNMS and BNP, there is currently no legislative mandate to develop a management plan for the portion of the Florida Reef Tract north of BNP. Under the auspices of the U.S. Coral Reef Taskforce (USCRTF), The Florida LAS was developed to address the need for conservation of coral reefs off southeast Florida, north of BNP.

The **Southeast Florida Coral Reef Initiative (SEFCRI)**, administered by the Florida Department of Environmental Protection, Coral Reef Conservation Program, is a partnership of over 70 local, state and federal agencies and non-governmental organizations who share a common mission: *To develop and support the implementation of an effective strategy to preserve and protect southeast Florida's coral reefs and associated reef resources, emphasizing balance between resource use and protection, in cooperation with all interested parties* (<http://www.dep.state.fl.us/coastal/programs/coral/sefcric.htm>).

The SEFCRI arose from the need for research and management to reduce threats to coral reefs on the northern third of the Florida coral reef ecosystem. Research has been conducted, and data collected, in this region since SEFCRI's inception in 2004. SEFCRI is currently transitioning from a data collection phase into a management action phase. In the SEFCRI Management Options Identification Process, stakeholder working groups will use the results of nearly ten years of SEFCRI partner research, monitoring and assessments to make management recommendations to appropriate local, state and federal agencies to conserve coral reef and reef-associated resources in southeast Florida and develop a coordinated management plan.

The subtropical climate and warm waters of the Florida Current provide conditions suitable for the northernmost coral reef in the western Atlantic. Over 6,000 marine animals and plants are found on the Florida Reef Tract, which is the third largest contiguous coral reef tract in the world. Habitat connectivity of the Florida Coral Reef tract with back reef habitats such as seagrass, mangroves, unconsolidated sediments (such as tidal flats) and other estuarine and marine habitats is important for the long-term sustainability of this important ecosystem.

Information about the status of reef fish assemblages on southeast Florida coral reefs is limited; however, three studies that address the status of reef fish in the SEFCRI region include 1) Johnson and others (2007), who profiled all commercial and recreational marine fisheries in the SEFCRI region using available fishery dependent data, 2) Ferro and others (2005) conducted a fishery-independent, visual census (fish counts) on natural reef habitats off Broward County and 3) Ault and Franklin (2011) who conducted a review and synthesis of fishery-dependent information from state and federal agency data sets for the SEFCRI region.

Key Findings from Johnson and others (2007):

Over the 11 year study period (1990-2000):

- 261 species, including reef fish, coastal, offshore pelagic, and invertebrates, were recorded in landings in southeast Florida.
- Mean total annual landings for all fisheries was 21.4 million pounds per year (range 17.7-26.9)
- Landings by sector: 66% recreational, 31% commercial, and 3% headboat landings.
- Total finfish landings declined 22% (23.2 to 18.1 million pounds) over the study period ($p = 0.022$).
- For reef fishes total annual landings from all sectors averaged 4.79 million pounds and were composed of 68% recreational, 27% commercial, and 5% headboat landings.
- No significant trend was detected in total annual reef fish landings for the recreational sector, while significant declines were detected for both headboat and commercial sectors.

Key findings by Ferro and others (2005):

- A total of 86,463 fishes (approximately 130 fish per site) belonging to 208 species and 52 families were observed in counts.
- Species richness (number of different species), abundance (number of fish) and biomass of fishes (the amount of fish living in a given habitat, such as kilograms per square meter of reef) increased significantly on reef lines moving away from shore.
- Although 232 red grouper were at the 667 sample sites, only two red grouper were above the legal minimum size. No goliath or black grouper were recorded.
- A total of 10 gag, yellowfin, or scamp grouper was observed at the 667 sample sites, none were the legal minimum size.
- Among six snapper species, 219 of 718 (~30%) were of legal size.

Ault and Franklin's (2011) findings indicate that a majority of the exploited reef fish species in the southeast Florida region are experiencing overfishing and exist at unsustainable levels locally. Key findings by Ault and Franklin (2011):

- An examination of recreational and commercial fisheries-dependent data showed that the fishery species had predominantly declining or unchanged trends in fisheries landings and effort for 1990 to 2008.
- Estimated headboat landings for five of the eleven reef fish species declined significantly from 1990-2006 but headboat angler days (fishing effort) also declined over the same time period.
- No significant declines in estimated marine recreational landings were found for 1990-2008 but this data encompassed the entire Florida east coast, not just the southeast Florida region.
- Commercial fishery landings in the southeast Florida region declined 73% from 485,000 pounds in 1990 to 178,000 pounds in 2006. (Note: FWC records show the number of commercial fishers in Florida decreased from a peak of 8,343 Saltwater Products license (SPL) holders in 1989 to 2,659 SPLs in 2001. This shift away from the commercial fishing sector may explain some of the decline in landings.)
- Of the 11 reef fish species assessed, black grouper, red grouper, mutton snapper, yellowtail snapper, hogfish, and angelfish experienced significant declines in commercial landings with associated declines in effort over that time period.
- Of the 11 reef fish species assessed using federal agency data, eight were below 30% Spawning Potential Ratio (SPR) and four were below 10% SPR. SPR is an estimate of the stock's spawning that would take place in the absence of fishing. The 30% and 10% thresholds are used by fishery managers to determine status (i.e. sustainable fishing SPR>30%, overfished SPR<30%, unsustainable stock levels SPR<10%)

Other key information:

- High species diversity and an intricate food web on coral reefs make stock assessment and fisheries management difficult.
- Southeast Florida has abundant reef habitat, but low abundance of grouper and snapper.
- Catch rates and landings of snapper and grouper have declined in headboat and commercial fisheries.
- While estimated catch rates have remained at consistent levels in the recreational fishery, the size of fish has declined, indicating these fish are being harvested at unsustainable levels in the SEFCRI region.

A review of marine resource management in Florida has shown four management approaches have been used to varying degrees: species-based management, activity-based management, place-based management and ecosystem-based management.

Species-based management addresses management needs on an individual species, without consideration of its environment or ecology.

Activity-based management addresses human activities to reduce or prevent adverse effects from an activity to natural resources or to direct human activities in ways to reduce user conflicts.

Place-based management addresses a broad range of management actions to protect specific locations, specific habitats or larger areas of important, connected habitats.

Ecosystem-based Management considers many of the same biological issues as species-based management and the physical and ecological issues in place-based management, as well as consideration of human cultural, social, and economic issues as they occur within and affect the ecosystem.

Each type of management approach has advantages and disadvantages specific to the management type. Successful management plans, such as the Florida Keys National Marine Sanctuary Revised Management Plan, usually incorporate a combination of these approaches or management tools to balance natural resource protection with continued use of these resources. None of these management approaches can be successful without the participation and support of coral reef stakeholders including fishers, divers, tourism, and marine industries in southeast Florida.

2. Coral Reef Management in Florida

2.1 Overview

The world's coral reefs and associated seagrass and mangrove habitats are in serious jeopardy, threatened by an increasing array of over-exploitation, pollution, habitat destruction, invasive species, disease, bleaching, and global climate change (USCRTF 2000). The rapid decline of these ancient, complex, and biologically diverse marine ecosystems has significant social, economic, and environmental impacts in the U.S. and around the world (USCRTF 2000). As is the case elsewhere, human activities and natural phenomena are affecting the Florida Reef Tract (DEP 2004).

The need for management of coral reefs in Florida was first recognized in the Florida Keys over 50 years ago and is only recently being expanded to the entire Florida Reef Tract. In 1960, John Pennekamp Coral Reef State Park was established off Key Largo to address the observed declines of coral reefs in the Keys. Biscayne National Monument was designated in 1968 to preserve the natural and cultural resources found there, for present and future generations. Continued environmental degradation prompted the eventual designation of Key Largo National Marine Sanctuary in 1975 and Looe Key National Marine Sanctuary in 1981. During the 1980s, oil drilling proposals, reports of deteriorating water quality, and evidence of declines in the health of the coral reef ecosystem continued (NOAA 2007). These threats, combined with several large vessel groundings, prompted Congress to act. President George H. Bush signed into law the bill establishing FKNMS in 1990. The new sanctuary incorporated the Key Largo and Looe Key sanctuaries as well as the John Pennekamp Coral Reef State Park to protect approximately 2,800 square nautical miles of waters in the Florida Keys (NOAA 2007). With the designation of FKNMS, several protective measures put into place, such as a prohibition of oil exploration, mining, or any type of activity that would alter the seafloor and restrictions on large vessel traffic (NOAA 2007). The addition of the Tortugas Ecological Reserve in 2001, the FKNMS now protects approximately 2,900 square nautical miles of the Florida coral reef ecosystem. Source: <http://floridakeys.noaa.gov/history.html>

Biscayne National Park (BNP) (Figures 1 and 2) was designated in 1980, expanding the managed area to approximately 206 square nautical miles of mostly marine habitats and superseding the previously designated Biscayne National Monument "...to preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty, there is hereby established the Biscayne National Park...in the State of Florida." Biscayne National Park incorporates marine habitats landward of the 10 fathom (60 foot) depth contour in the Atlantic Ocean, as well as portions of Biscayne Bay.

Sources: <http://www.nps.gov/bisc/parkmgmt/enabling-legislation.htm> and <http://www.nps.gov/bisc/parkmgmt/planning.htm>

Unlike the FKNMS and BNP, there is currently no legislative mandate to develop a management plan for the portion of the Florida Reef Tract north of BNP. However, the U.S. Coral Reef Task

Force (USCRTF) directed federal agencies and U.S. jurisdictions with coral reefs to develop Local Action Strategies (LAS) to address the widespread need for coral reef conservation. The Florida LAS was developed to address the need for conservation of coral reefs off southeast Florida (Miami-Dade, Broward Palm Beach and Martin Counties) (DEP 2004). As outlined above, the Florida Keys National Marine Sanctuary and other parks had been previously designated, resulting in coordinated management of the southern two thirds of the Florida Reef Tract. Early in the USCRTF LAS process, the lack of information and need for management along the northern third of the Florida Reef Tract were identified by the planning team as critical needs for the conservation of these coral reefs (DEP 2004). In response to these needs, the Southeast Florida Coral Reef Initiative focused on the northern third of the Florida Reef Tract and includes focus areas that were developed to address key threats or issues relating to the conservation and management of coral reef habitat in Florida. The SEFCRI region consists of the northern third of the Florida Reef Tract extending approximately 110 miles from the northern boundary of Biscayne National Park to St. Lucie Inlet (Figure 2).

Source: <http://www.dep.state.fl.us/coastal/programs/coral/sefcric.htm>

2.2 Florida Keys National Marine Sanctuary

The [Florida Keys National Marine Sanctuary and Protection Act](#) called for the development of a comprehensive management plan. Public scoping meetings, followed by a series of workshops, collected input from federal, state, and local interests. These meetings, workshops, and extensive public input laid the foundation for the [sanctuary management plan](#) that was ultimately implemented in July 1997 (NOAA 2007). The FKNMS originally protected 2,800 square nautical miles of waters. The FKNMS was subsequently expanded in 2000, now protecting a total of 2,900 square nautical miles of waters using an approach that addresses the variety of impacts, pressures, and threats to the Florida Keys ecosystem. The sanctuary is administered by NOAA and is jointly managed with the State of Florida (NOAA 2007). The Florida Keys National Marine Sanctuary protects waters surrounding the Florida Keys, from south of Biscayne National Park westward to encompass the Dry Tortugas, excluding Dry Tortugas National Park. The shoreward boundary of the sanctuary is the mean high-water line. Within the boundaries of the sanctuary lie spectacular, unique, and nationally significant marine habitats, from the world's third largest barrier reef, extensive seagrass beds, mangrove-fringed islands, and more than 6,000 species of marine life (NOAA 2007). The sanctuary also protects pieces of our nation's history such as shipwrecks and other archeological treasures. In 1990, FKNMS became the ninth sanctuary to join the system, in response to concerns about the decline of the reef ecosystem in the area. Source: <http://floridakeys.noaa.gov/history.html>

2.3 Tortugas Ecological Reserve

The Dry Tortugas area contains diverse habitats, including seagrass beds, patch reefs, fore reefs, intermediate, and deep reefs, and hardbottom areas. The deep coral reefs of the Tortugas are the crown jewel of Florida Keys National Marine Sanctuary, one of America's last wild ocean places. Since it is located west of the Florida Keys, it is up current from many of the anthropogenic impacts affecting the rest of the Florida Reef Tract. Clean, clear water and strong ocean currents support the diversity of life in the Dry Tortugas region. The Tortugas region forms a crossroads of major ocean currents, which carry larvae of fish, lobster, and other animals

to coastal nurseries and the Florida Keys. These same currents bring larvae of fish and other creatures to the Tortugas from both the Gulf of Mexico and the Caribbean Sea. As a result, more than 400 species of reef fish inhabit the Tortugas region.

Source: <http://floridakeys.noaa.gov/zones/ers/tortugas.html>

The Tortugas Ecological Reserve was developed to protect sensitive and relatively unspoiled marine habitats and reef fish assemblages. These protections were implemented as use zones under the auspices of the Florida Keys National Marine Sanctuary. Two zones on the west side of the Dry Tortugas National Park were included in the Tortugas Ecological Reserve, North Area and South Area (Figure 3).

2.4 Biscayne National Park

Originally designated a National Monument in 1968, congress authorized the expansion and designation of designated Biscayne National Park in 1980. Biscayne National Park has a dual mandate that includes protecting the valuable natural resources within park boundaries for future generations while allowing use of those natural resources by park visitors. BNP encompasses 175,000 acres (approximately 206 square nautical miles), of which, approximately 95% of is water (NPS 1983).

Biscayne National Park consists of four primary ecosystems:

- a narrow fringe of mangrove forest along the mainland shoreline;
- the southern expanse of Biscayne Bay;
- the northernmost islands of the Florida Keys; and
- a portion of the third-largest coral reef in the world.

Each of these ecosystems consists of a variety of smaller ecological communities such as seagrasses, mangroves, hardbottom, and coral reefs in the water, as well as beach/dune communities and sub-tropical hardwood hammocks on land. The geology of the area has been influenced by changing sea levels, currents, hurricanes, and reef-building organisms like corals. South Florida's subtropical climate produces forest types that are more typical of the Caribbean than of mainland North America.

Source: <http://www.nps.gov/bisc/naturescience/naturalfeaturesandecosystems.htm>

2.5 Southeast Florida Coral Reef Initiative

The mission of the Southeast Florida Coral Reef Initiative (SEFCRI) is: *To develop and support the implementation of an effective strategy to preserve and protect southeast Florida's coral reefs and associated reef resources, emphasizing balance between resource use and protection, in cooperation with all interested parties.*

(<http://www.dep.state.fl.us/coastal/programs/coral/sefcricri.htm>).

Coordinated management actions within Florida and other jurisdictions (e.g. FKNMS, USVI) have shown that the rate of coral reef and associated seagrass and mangrove habitat declines can

be slowed; however, there is currently no comprehensive management of coral reef ecosystem resources on the northern third of the Florida Reef Tract, nor is there a consistent approach to reduce threats to coral reef ecosystem resources in this region.

Since 2003, over 70 partners have been working through SEFCRI to implement 140 projects to reduce threats to coral reefs in this area. Substantial progress has been made in collecting information needed to move forward with management planning for southeast Florida coral reefs. Under the Florida LAS, southeast Florida coral reefs have been surveyed with laser measuring systems, mapped with Geographic Information Systems (GIS) and sampled for biological assessments and monitoring by SEFCRI partners. Water quality effects on southeast Florida reefs have been studied, including ocean outfall and coastal inlet water quality sampling to determine types and amounts of pollutants. Evaluations of regional reef fish assemblages have been conducted using fishery-dependent information. Fishery-independent information is currently being collected by SEFCRI partners. Reef user patterns (fishers, divers, snorkelers, and boaters) have been quantified by aerial surveys and their perceptions surveyed by mail, telephone, and interview. Socioeconomic studies touting the benefits of southeast Florida reefs to the local economy have been conducted. The outcomes and products from the efforts have laid the foundation for stakeholders to recommend management actions, and subsequently developing the first management plan for southeast Florida coral reefs. SEFCRI project reports can be found at: <http://www.dep.state.fl.us/coastal/programs/coral/reports/>

2.5.1 Status of Coral Reefs in the SEFCRI Region

The portion of the Florida Reef Tract from the northern boundary of BNP to Martin County is characterized as a high-latitude coral reef ecosystem that supports a diverse assemblage of sponges, soft coral, sea fans and 2-3% cover by stony corals (Gilliam and Karazsia 2012a). Coral reefs and reef ecosystem components such as mangrove, seagrass, and hardbottom habitats have been degraded by human activities such as coastal construction, port and channel dredging, large ship grounding and anchor impacts, anchor and gear impacts from fishing and diving activities, beach nourishment, and water pollution through inlets and ocean outfalls (Gilliam and Karazsia 2012a). Sites within this segment of the Florida Reef Tract were monitored from 2003 to 2011 (Gilliam 2011). Results of this monitoring indicate the benthic components of the southeast Florida reef system has been relatively stable (Gilliam 2011). Macroalgae (aquatic or marine multi-celled plants that lack roots, stems, and leaves) and octocorals (soft corals and sea fans) are the functional groups with the highest cover throughout the region, with no statistically significant changes in trends through the monitoring period (Gilliam 2011). While recent estimates of the current status of coral reef resources remain relatively stable (Gilliam 2011), the current condition of these reefs is the result of over a century of habitat loss and degradation from human impacts to estuarine and marine habitats (PBC 2008) that support **biological assemblages** (groups of plants and animals that occur together) on the northern third of the Florida Reef Tract (Ault 2012). The recent monitoring activities began after much degradation had already occurred (DEP 2004).

2.5.2 SEFCRI Management Planning

Under the coordination of DEP CRCP, SEFCRI is developing and will implement a process where key partners and coral reef stakeholders in the region will work to identify potential management options that could be applied to reduce negative impacts to, and to better conserve and manage, southeast Florida coral reefs (<http://www.dep.state.fl.us/coastal/programs/coral/>). The SEFCRI “Management Options Identification Process” will be stakeholder-driven and will determine what management approaches should be used to address threats to southeast Florida coral reefs, and where and how to apply each option.

Coordinated by DEP, SEFCRI is planning a transparent and open process that will bring together key stakeholders representing the major users of coral reef resources in southeast Florida such as fishers, divers, scientists, government agencies, and environmental organizations; and ask them to work together as a part of organized working groups to develop a set of management recommendations for the region. The process will also include two series of public meetings, where all are welcome, to introduce the management process, and to vet the recommendations of the working groups with all interested parties. DEP will then provide the final recommended management options to the appropriate agency or agencies to consider for implementation.

2.6 Summary

- Management of Florida coral reef habitats began as early as 1960 in response to threats from ship groundings and declining coral reef ecosystem functions related to declines in water quality in the Florida Keys
- Currently, the southern 2/3 of the Florida reef tract is under coordinated management by state and federal agencies who work closely with non-governmental organizations, local agencies, businesses and residents of the Florida Keys.
- The southeast Florida Coral Reef Tract includes benthic assemblages dominated by soft corals, sponges and algae and have a very low percent cover by stony corals. These benthic assemblages occur on reef framework and hardbottom that are interspersed with large expanses of other habitats.
- The Southeast Florida Coral Reef Initiative is building partnerships and capacity to improve management of the northern 1/3 of the Florida coral reef ecosystem.

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Figure 1. Map showing the Florida Reef Tract, Florida Keys National Marine Sanctuary, Biscayne National Park, and the Southeast Florida Coral Reef Initiative region.
 Source: Florida Department of Environmental Protection, Coral Reef Conservation Program

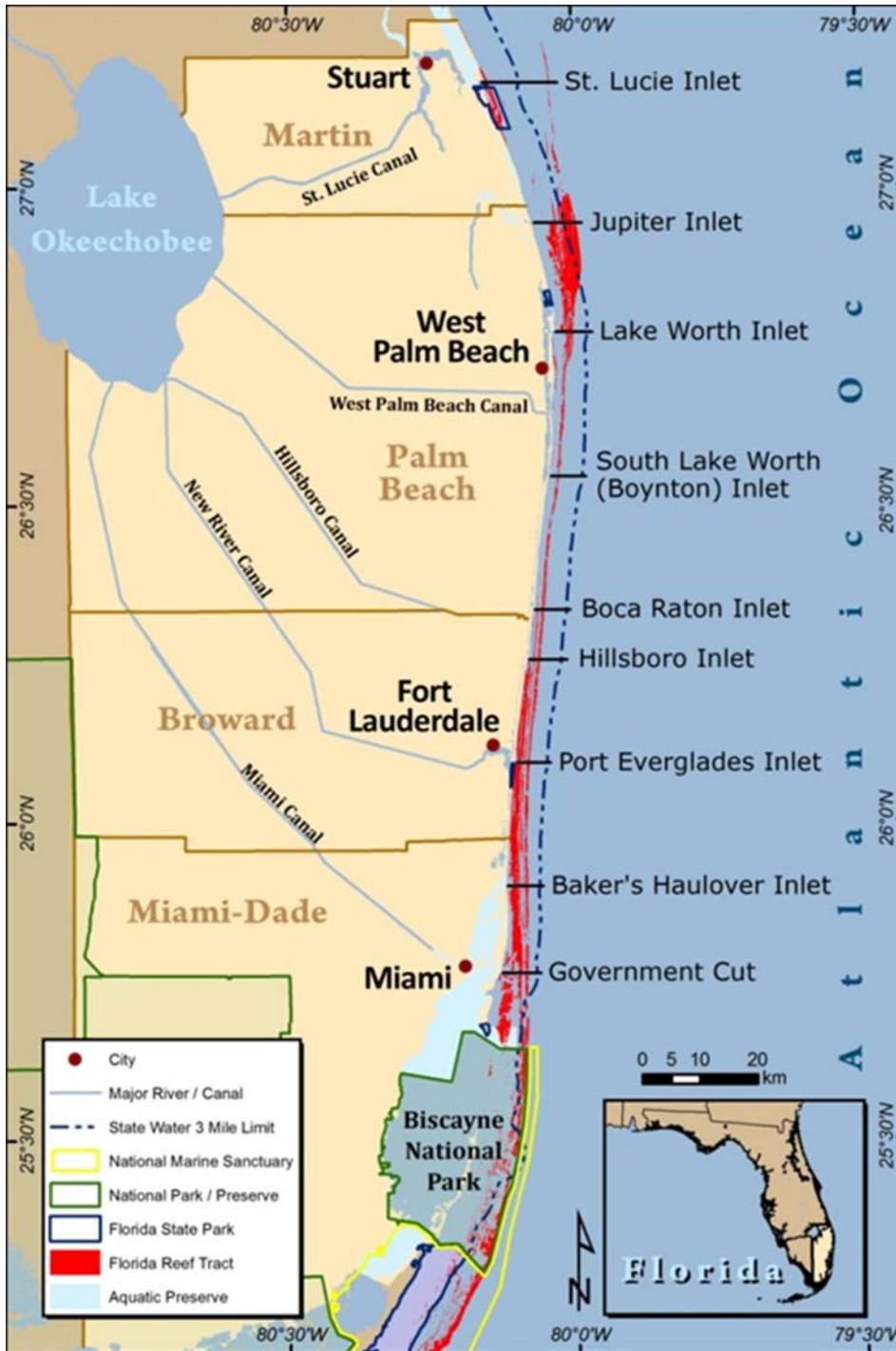


Figure 2. Southeast Florida Coral Reef Initiative (SEFCRI) Region: Miami-Dade to Martin counties.

Tortugas

Ecological Reserve

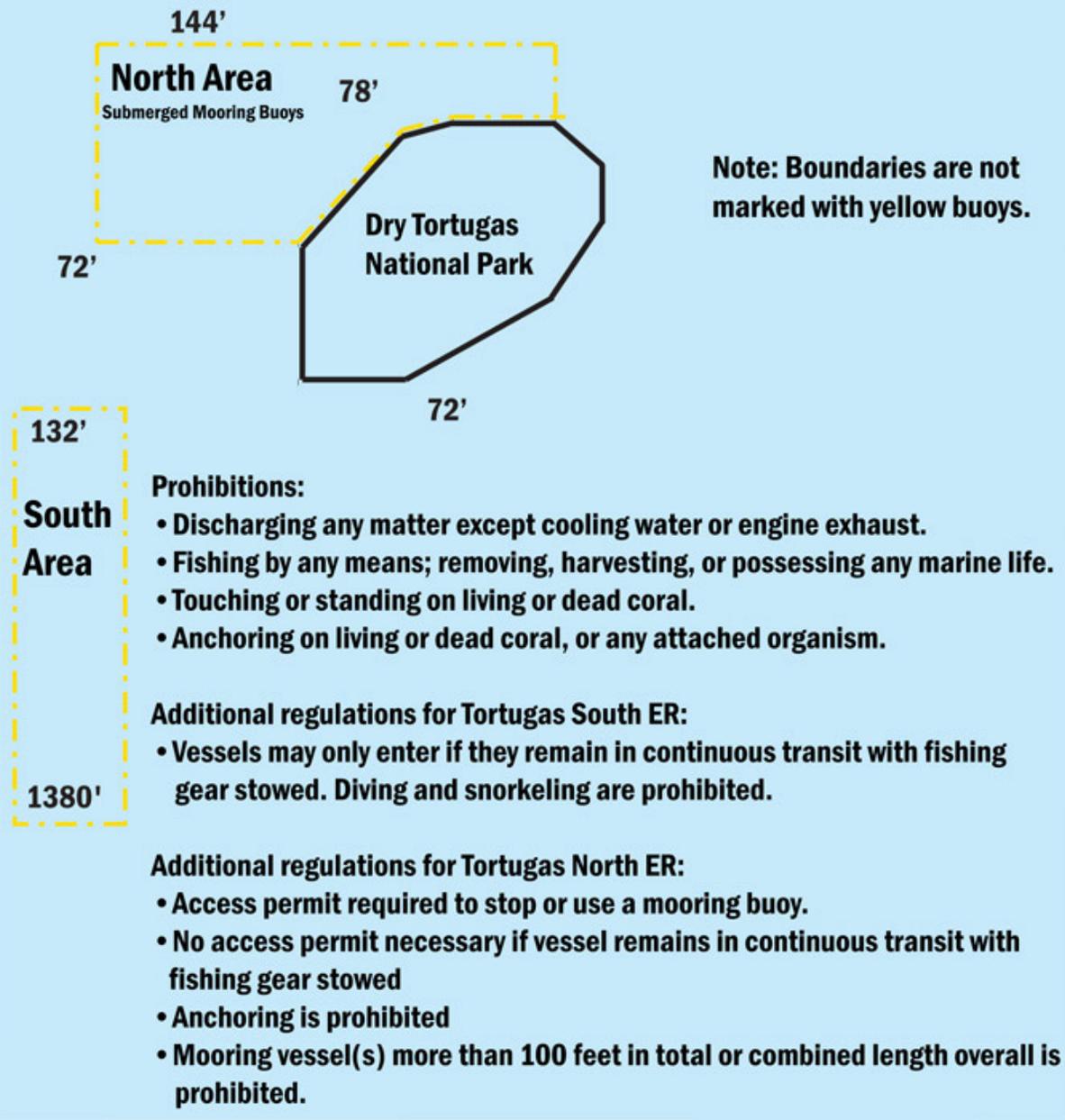


Figure 3. Tortugas Ecological Reserve map and management actions.

Source: <http://floridakeys.noaa.gov/zones/ers/tortugas.html>

3 Fish and Fisheries in the Southeast Florida Region

3.1 Overview

The subtropical climate and warm waters of the Florida current provide conditions suitable for the northernmost coral reef in the western Atlantic (NOAA 2007). Over 6,000 marine animals and plants are found on the Florida Reef Tract, which is the third largest contiguous coral reef tract in the world (NOAA 2007). **Reef fish assemblages** (groups of reef fish species that occur together) in southeast Florida include snappers, groupers, triggerfish, barracuda, jacks, sharks, and rays, as well as smaller fish, like grunts, butterflyfish, filefish, wrasses, damselfish, angelfish, gobies, and blennies. Grazing fish, such as surgeonfish, doctorfish, blue tang, and parrotfish are important for maintaining the coral-algae balance on coral reefs. These grazing fish eat algae from the reef substrate, which provides space for new corals to recruit and keeps algae from out competing corals for space and light.

Other fish use coral reef and hardbottom habitats opportunistically. For example, pilchards, glass minnows (silversides), ballyhoo and jacks (blue runners, cigar minnows and goggle eyes) will use the reef for shelter. King, Spanish and cero mackerel, little tunny (bonita), and blackfin tuna will come to the reefs to feed on these baitfish. The large gamefish that make up the majority of the recreational fishery in the southeast Florida region, such as wahoo, dolphin, and sailfish, come to the reefs to feed on the blackfin tuna, little tunny, and baitfish. Fishermen targeting these species will often focus on a depth range of 60 to 120 feet that typically includes coral reef habitats along the southeast Florida coast. These are only a few examples of the connections between fisheries species and the complex network of trophic levels in the food web supported in the southeast Florida coral reef ecosystem.

A **food web** is a representation of how energy is produced by plants and passed on to organisms of other trophic levels. **Trophic level** is a term used by scientists to describe where energy is produced and passed on through the food web of an ecosystem. Trophic levels are often characterized as producers (plants that produce energy from sunlight), primary consumers (grazers), secondary consumers, and apex predators. Organisms can fit into a number of different trophic levels throughout their life history. An example of a simple food web (previously described as a food chain) would be grass converting sunlight, nutrients, and other chemicals into sugars (**producers**). Cattle consume grass and extract the energy and nutrients to grow larger (plant eaters are called **primary consumers** or grazers). Humans consume cattle, making them **secondary consumers** and the **apex** organism in this food web. Each time energy is passed on to another trophic level, most of it is lost to the next trophic level. This is why it takes a lot of producers and primary consumers to support higher level consumers.

In coral reef ecosystems, food webs are very complex. Algae, seagrass, and **phytoplankton** (tiny plants that live in the water column) provide the production that supports marine ecosystems. Primary consumers like grazers on the reef or small animals that eat phytoplankton in the water column (zooplankton), consume this production. These animals are eaten by larger animals like glass minnows, pilchards and ballyhoo, which are eaten by predatory fish. Each of these trophic links adds a line to the food web. A sustainable coral reef ecosystem typically has many linkages in the food web.

Coral reef ecosystems consist of a mosaic of interconnected habitats including the reef tract and **back reef habitats**, which are defined in Adams et al. (2006) as fisheries habitats landward of the reef crest, along the beach and shoreline, within a lagoon or bay and within estuarine tidal creeks and wetlands. Southeast Florida estuaries consist of fisheries habitats including mangrove, seagrass, oyster habitats and tidal mud or sand flats open water channels between these habitats and tidal creeks and rivers. While the term *back reef* usually applies to barrier reef-lagoon ecosystems in the tropics (Adams et al. 2006), the interconnected habitat usage by marine and estuarine animals observed in tropical back reef habitats is also observed in subtropical Florida coral reef ecosystem (Eggleston et al. 2004, Jones et al. 2010). Fish, crustaceans and other marine animals use these interconnected habitats within southeast Florida estuaries and off the coast as nursery habitat (SAFMC 2009, Lindeman and Snyder 1999, Eggleston et al. 2004, Jones et al. 2010) in the manner described in Adams et al. (2006) as back reef habitats.

In addition to the many species inhabiting the southeast Florida coral reefs, each with their unique niches (roles) in the ecosystem, the trophic position of animals within a species can also change as fish grow larger. For example, even species which are apex predators (at the top of the food web), such as Goliath grouper, can be prey when they are young and small. Such complex interactions between and within species makes research and management of fish in coral reef ecosystems very challenging.

Additional information on southeast Florida coral reef ecology, fish and habitats can be found in the book titled Tropical Connections: South Florida's Marine Environment (W.L. Kruczynski and P.J. Fletcher, Editors) published in 2012 by IAN Press.

3.2 Fisheries Management

Fisheries science is a multi-disciplinary field of study that looks at understanding and managing the effects of human harvest of aquatic life. One set of tools fisheries managers use is called **stock assessment**. An overview of stock assessment vocabulary and methods is available at: <http://www.seagrant.unh.edu/newsstock.html> (Cooper 2006). **Fishery management plans** incorporate the results of stock assessments and other parameters such as social, cultural, economic and natural resource user information to address balancing the human needs and wants

for fish from the stock with the biological needs of the stock to remain sustainable. A couple important terms in stock assessments from Cooper (2006) include:

- **Maximum Sustainable Yield (MSY):** stock size that can produce maximum sustainable yield when it is fished at a level equal to the fishing mortality rate that results in MSY;
- **Optimum Sustainable Yield (OSY):** the amount of catch that will provide the greatest overall long-term benefit to society. Optimum yield must take into account the fish biology inherent in maximum sustainable yield, as well as economics and the attitudes of the public towards risk and environmental protection. The OSY can never be greater than maximum sustainable yield.

These traditional approaches to fisheries management concepts have worked sufficiently in many single-species or low diversity fisheries (Mace 2004). The MSY and OSY concepts have been more difficult to apply to high-diversity reef fish populations, where fish population parameters and ecological connections are more dynamic, where fishery resources cross geopolitical boundaries, and where human actions are more difficult to monitor and manage (Christie et al. 2007, McClanahan et al. 2011). Stock assessments generally require data on catch, relative abundance, and the life history of the species in question. Both fishery-dependent and fishery-independent data can help fulfill these needs (Cooper 2006). **Fishery-dependent** data are derived from the fishing process itself and are collected through such avenues as self-reporting, onboard observers, portside surveys, telephone surveys or vessel-monitoring systems (Cooper 2006). **Fishery-independent data** are derived from activities that do not involve the commercial or recreational harvest of fish, such as trawl, acoustic, video and side-scan sonar research surveys and some tagging experiments (Cooper 2006). Visual fish counts have provided important fishery-independent data on reef fish in the Florida Keys for decades.

Stock assessments are used to inform fisheries management planning efforts. Reef fish in southeast Florida are usually assessed by the National Marine Fisheries Service, in consultation with the Florida Fish and Wildlife Conservation Commission for use in Fishery Management plans developed and approved through the South Atlantic Fishery Management Council. Federal fisheries management plans for the Snapper/Grouper complex (reef fish) and other important fisheries can be found at: <http://www.safmc.net/default.aspx?tabid=395>

3.3 Reef Fish Status in Southeast Florida

Information about the status of reef fish assemblages on southeast Florida coral reefs is limited. Three studies that address the status of reef fish in the SEFCRI region include 1) Johnson and others (2007), 2) Ferro and others (2005) conducted a fishery-independent, visual census (fish counts) on natural reef habitats off Broward County and 3) Ault and Franklin (2011) who conducted a review and synthesis of fishery-dependent information for the SEFCRI region.

Johnson and others (2007)

Johnson and others conducted a review of available fisheries-dependent data over an 11 year study period (1990-2000) and found:

- 261 species, including reef fish, coastal, offshore pelagic, and invertebrates, were recorded in landings in southeast Florida.
- Mean total annual landings for all fisheries was 21.4 million pounds per year (range 17.7-26.9)
- Landings by sector: 66% recreational, 31% commercial, and 3% headboat landings.
- Total finfish landings declined 22% (23.2 to 18.1 million pounds) over the study period ($p = 0.022$).
- For reef fishes total annual landings from all sectors averaged 4.79 million pounds and were composed of 68% recreational, 27% commercial, and 5% headboat landings.
- No significant trend was detected in total annual reef fish landings for the recreational sector, while significant declines were detected for both headboat and commercial sectors.

Ferro and others (2005) conducted a point-count, visual census of fish from 1998 to 2002 off Broward County, Florida, where they identified and counted fish at 667 sites on natural reefs.

- A total of 86,463 fishes (approximately 130 fish per site) belonging to 208 species and 52 families were observed in counts.
- Species richness (number of different species), abundance (number of fish) and biomass of fishes increased significantly on each of three reef tracts (Shallow, Middle and Deep reefs) moving away from shore.

The authors found that differences in fish abundance and species composition may be due to a number of variables, such as depth, current, refuge, food availability, and other habitat preferences. Of management interest, was a scarcity or absence of groupers and snappers observed over four years.

- Although 232 red grouper were sighted at the 667 sample sites, only two (<1%) red grouper were above the legal minimum size.
- No goliath or black grouper were recorded.
- A total of 10 gag, yellowfin, or scamp grouper were observed; none were at the legal minimum size.
- Among six snapper species, 219 of 718 were of legal size (~30%).

Ault and Franklin (2011) conducted an evaluation of reef fish status in southeast Florida using fisheries-dependent information that built on the findings of Johnson and other (2007).

Recreational and commercial fisheries-dependent data from 1990 to 2008 showed that the fishery species had predominantly declining or unchanged trends in fisheries landings and effort for the study period. The status of the red grouper, black grouper, mutton snapper, gray snapper, yellowtail snapper, hogfish, white grunt, tomtate, great barracuda, gray triggerfish, greater

amberjack, blue angelfish, queen angelfish, rock beauty, French angelfish, gray angelfish, and spiny lobster were examined using catch and effort data from fishery-dependent datasets and compared to State of Florida benchmarks. Trends (increasing, decreasing, unchanging, or unknown) were used as indicators of the condition of fish populations and fisheries in the southeast Florida region.

- Estimated headboat landings for five of the eleven reef fish species declined significantly from 1990-2006 but headboat angler days (fishing effort) also declined over the same time period.
- No significant declines in estimated marine recreational landings were found for 1990-2008 but this data encompassed the entire Florida east coast, not just the southeast Florida region.
- Marine aquaria commercial landings and effort of angelfish declined significantly from 1994 to 2009.
- Spiny lobster commercial fishery landings and effort declined significantly from 1990 to 2009.
- Commercial fishery landings in the southeast Florida region declined 73% from 485,000 pounds in 1990 to 178,000 pounds in 2006.
- Black grouper, red grouper, mutton snapper, yellowtail snapper, hogfish, and angelfish experienced significant declines in commercial landings with associated declines in effort over that time period.

Reef fish in Florida are managed jointly by the State of Florida in state waters and by the South Atlantic Fishery Management Council and National Marine Fisheries Service (NMFS) in federal waters. Reef fish stock assessment is conducted by the NMFS in coordination with the state. Fisheries benchmarks, e.g. levels of fishing mortality compared to fishing mortality at MSY and spawning potential ratio (SPR) were used as indicators of population status for all species with adequate catch, size, and life history information (Ault and Franklin 2011). SPR is the ratio of the total biomass of mature fish (usually mature females) in a fished population to the total biomass that would exist if the population was not fished (FWC 2012). Mean size (length) of animals in the exploited part of the population was estimated from three fishery-dependent size composition data sets (Trip Interview Program, Headboat Survey, and Marine Recreational Fisheries Statistics Survey) and used as an indicator of exploitation rates and fish population condition. After review of the datasets, fishing mortality rates estimated from various data sources were comparable. All species but greater amberjack experienced a level of fishing effort exceeding a sustainable rate (where fishing mortality rate of the population divided by the Fishing mortality rate at maximum sustainable yield is greater than 1.0) (Ault and Franklin 2011). Of the 11 reef fish species assessed, eight were below 30% SPR (overfished) and four were below 10% SPR (unsustainable) (Ault and Franklin 2011). These findings suggest that a majority of these reef

fish species in the southeast Florida region are experiencing overfishing and exist at unsustainable levels (Ault and Franklin 2011)

Reef fishery management currently employed in the southeast Florida region includes: minimum size limits, bag limits, gear restrictions, prohibited species, and time closures. Spatial closures are not currently used in the southeast Florida region, although they are commonly used for reef fish management elsewhere, including the Florida Keys, the Dry Tortugas, and along Florida's east and west coasts for deep water reef fishes in federal waters (Ault and Franklin 2011). Fishery management options specific to southeast Florida are most likely limited to effort restrictions in the form of spatial closures for the species in decline but any actions undertaken should be framed within the context of the entire fishery domain, not just the southeast Florida region (Ault and Franklin 2011). The most critical information need is fisheries-independent surveys of reef fish targeted by fisheries in the southeast Florida region that integrate with existing survey efforts (Ault and Franklin 2011).

3.4 Summary

- The Florida Reef Tract is home to over 6,000 species of plants and animals.
- High species diversity and an intricate food web on coral reefs make stock assessment and fisheries management difficult.
- Southeast Florida has abundant reef habitat, but low abundance of grouper and snapper.
- Catch rates and landings of snapper and grouper have declined in headboat and commercial fisheries.
- While estimated catch rates have remained at consistent levels in the recreational fishery, the size of fish has declined, indicating these fish are being harvested at unsustainable levels.

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4 Fisheries and Coral Reef Management

Agencies in Southeast Florida

4.1 Introduction

The following information is intended to provide coral reef stakeholders with an overview and understanding of the agencies and entities responsible for managing fisheries and coral reef resources in southeast Florida (Figure 1). While federal and state agencies may appear to have similar focus, each agency has different responsibilities and authorities. Understanding these differences may be important in the development of stakeholder working group recommendations for management options of southeast Florida coral reefs and reef fish.

In Florida, responsibility for managing corals is shared by the DEP and FWC. Harvest of corals and coral reef-associated organisms are managed by the FWC. DEP manages coral reef habitats as a public natural resource located on state-owned sovereign submerged lands.

4.2 Agencies

Agency: **Florida Fish and Wildlife Conservation Commission (FWC)**

Mission: *To manage fish and wildlife resources for their long-term well-being and the benefit of people.*

Marine Jurisdiction: Florida territorial waters (up to 3 nautical miles from Florida's Atlantic coastline and up to 9 nautical miles from Florida's Gulf of Mexico coastline).

Constitutional Authority: Article IV, Section 9 of the Florida Constitution mandates that FWC shall exercise the regulatory and executive power of the state with respect to wild animal life, fresh water aquatic life and marine life. To comply with this mandate, FWC has developed and implemented numerous administrative rules, which are continually amended and subject to rule challenges. FWC also manages several licensing and permitting programs ranging from licensing the possession of captive wildlife to the licensing of commercial fishermen. Consequently, the agency defends challenges to license and permit denials, license revocations, fines, and license suspensions. The agency also has over 700 sworn law enforcement officers who enforce FWC regulations, as well as other state and federal laws. State and federal prosecutors handle the criminal cases resulting from the enforcement activities of these officers. Source: <http://www.fladminlaw.org/pdf/fwcc.pdf>

The FWC's seven Commissioners are appointed by the Governor and confirmed by the Florida Senate to five-year terms.

Marine Management Responsibilities: The FWC, Division of Marine Fisheries Management develops regulatory and management recommendations for consideration by FWC Commissioners designed to ensure the long-term conservation of Florida's valuable marine fisheries resources. Division staffs serve as liaisons to a number of federal agencies on marine issues and represent the state on the Gulf of Mexico Fishery Management Council and South Atlantic Fishery Management Council. Division activities include: recreational and commercial marine fisheries outreach and education programs; facilitating artificial reef development and deployment; preparation of fishery strategic plans; issuance of special activities licenses; conducting wholesale fish dealer audits, and assisting trap retrieval efforts. Source: <http://myfwc.com/fishing/saltwater/>

How the agency's rules are made: The seven FWC Commissioners, meet five times each year to hear staff reports, consider rule proposals, and conduct other Commission business. Because stakeholder involvement is a crucial part of the process, they conduct Commission meetings in different locations across the state offering citizens the opportunity to address the Commission about issues under consideration.

The FWC is responsible for enacting and enforcing rules and regulations governing human activity in many areas - such as hunting and fishing, operating boats, possessing captive wildlife, and dealing with nuisance animals. Because rules are made, changed, and repealed throughout the year, agency staff frequently interacts with affected individuals and the public. The FWC abides by Ch. 120, Florida Statutes, when making rules. In doing so, they notify the public of rulemaking activity through the Florida Administrative Weekly. Rulemaking often includes direct contact with those who may be affected, extensive discussions with stakeholder groups, and public meetings to gather input from interested parties. Final decisions on rules usually happen at Commission meetings. The FWC also provide public notice of various meetings through their website calendar. Source: <http://myfwc.com/about/rules-regulations/proposed-rule-changes/>

Agency: National Oceanic and Atmospheric Administration (NOAA) **National Marine Fisheries Service (NMFS)**

Mission: *Stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment.*

Jurisdiction: United States Exclusive Economic Zone (EEZ). The U.S. EEZ extends from state territorial waters (>3 nautical miles from Florida's Atlantic coast) to the limit of the EEZ; which is either 200 nautical miles from shore or a joint boundary with another nation less than 200 miles from shore.

Legislative Authority: The **Magnuson-Stevens Fishery Conservation and Management Act**, under which fisheries within the 200-mile Exclusive Economic Zone (EEZ) are regulated, places responsibility for fishery management jointly with the Secretary of Commerce (through NMFS) and eight Regional Fishery Management Councils which it established in 1976.

Under the **Endangered Species Act (ESA)**, NMFS, as delegated by the Secretary of Commerce, is responsible for the protection of those marine species listed as threatened or endangered, and for identifying candidate species for such listings. The ESA mandates that NMFS consults with other federal agencies to assess the impacts of actions that may affect listed species, and to minimize those impacts, either through regulation or otherwise. It also mandates conservation of critical habitat for threatened and endangered species. Recovery plans characterize and assess the species' habitat needs, assess the cumulative effects of environmental variability and human-related activities, and include provisions to protect and conserve the habitat. Further, ESA allows NMFS to establish cooperative agreements with states so that they can implement conservation and recovery actions for listed species.

Under the **Marine Mammal Protection Act (MMPA)**, NMFS, as delegated by the Secretary of Commerce, is responsible for protecting certain marine mammals, namely cetaceans and pinnipeds, excluding walruses. NMFS must protect all such cetaceans and pinnipeds, regardless of their population status. The MMPA mandates that by 2001, death of, and serious injury to, marine mammals incidental to commercial fishing operations must be reduced to insignificant levels approaching a zero rate. The MMPA establishes a long-range regime to govern interactions between marine mammals and commercial fisheries which include the requirement to assess all stocks in U.S. waters, continue the categorization of fisheries and registration of fishers based on their interaction with marine mammals, and implement take reduction plans as needed to achieve the zero mortality requirement.

Various statutes confer on NMFS a mandate to reduce and mitigate degradation and loss of living marine resource habitat. These include the **Clean Water Act, the Federal Power Act, the Fish and Wildlife Coordination Act, the Oil Pollution Act, and the Coastal Zone Management Act**, among others. Under these statutes, NMFS plays a primarily advisory role in reviewing proposed projects and other actions which may affect living marine resource habitat, and making recommendations for the adequate conservation of that habitat.

Source: <http://www.nmfs.noaa.gov/om2/mission.html>

Management Responsibilities:

The Sustainable Fisheries Division, Southeast Regional Office, National Marine Fisheries Service, is entrusted with the conservation, management, and protection of marine fishery resources inhabiting federal waters off the southeastern United States from North Carolina through Texas and Puerto Rico and the U.S. Virgin Islands. The Division is the Region's focal point for implementing NMFS' primary legislative authority for fisheries management and research, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), as amended by the Sustainable Fisheries Act (SFA).

The Division works directly with the Region's three fishery management councils established by Congress to perform the mandates of the Magnuson-Stevens Act. These mandates are accomplished through fishery management plans (FMPs) for marine finfish and invertebrates that support important commercial and recreational fisheries in the Gulf of Mexico, South Atlantic, and Caribbean and consider conservation and management issues, sociological and economic issues, and regulatory issues. Functions and activities required to fulfill this and other responsibilities as specified in the Magnuson-Stevens Act include: providing guidance on

fisheries management; providing technical assistance and advise in preparing FMPs in accordance with national standard guidelines and other applicable laws; coordinating public review and compilation of comments; initiating Secretarial review of FMPs and amendments; drafting regulations and Federal Register notices, as well as reviewing and responding to comments received during rulemaking; FMP implementation; and monitoring.
<http://sero.nmfs.noaa.gov/sf/sf.htm>

Under the **Magnuson-Stevens Act**, as amended by the **Sustainable Fisheries Act**, FMPs must contain conservation and management measures which prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery. These measures must be based on the best scientific information available, consider efficiency, minimize costs, avoid unnecessary duplication, minimize bycatch and the mortality of bycatch, and promote the safety of human life at sea. They must also provide for the sustained participation of fishing communities while minimizing adverse economic impacts on them, to the extent practicable and consistent with conservation aims and requirements. FMPs must also contain provisions to conserve essential fish habitat. This requires NMFS to establish guidelines to assist the Councils in the identification and conservation of such habitat, and to consult on all federal or state actions which could have adverse impacts on that habitat.

Voting members of the Fishery Management Councils represent diverse interests. The majority of representatives are appointed by the Secretary of Commerce based on recommendations from the governors of the states in each region; others are members by virtue of their responsibility for fisheries management at the state and federal levels. A number of fisheries based primarily in state waters are managed by Interstate Marine Fisheries Commissions established cooperatively among the relevant states, with support from NMFS. The Atlantic Coastal Fisheries Cooperative Management Act and the Atlantic Coast Striped Bass Conservation Act, under which many Atlantic coastal fisheries are managed, provide a special role for the Atlantic States Marine Fisheries Commission in management of certain fisheries in federal waters.

Together, the NMFS, the regional Councils, and the Interstate Marine Fisheries Commissions are responsible for preparing Fishery Management Plans for the Nation's fishery resources through extensive discussions with states, tribes, other federal agencies, fishers, processors, marketers, public interest groups, universities, and the general public, and through partnerships with international science and management organizations.

How the agency's fisheries rules are made: Fishery Management Plans (FMPs) for fisheries in the EEZ are developed by the Councils (See Council process below) and are approved by the Secretary of Commerce, through NMFS. Occasionally, FMPs are developed directly by NMFS, with advice and comment from the public, including the Councils. FMPs for coastal migratory fisheries are developed and implemented by states and Interstate Marine Fishery Commissions with support from NMFS.

Agency: **South Atlantic Fishery Management Council (SAFMC)**

Mission and Jurisdiction: *The South Atlantic Fishery Management Council is responsible for the conservation and management of fish stocks within the federal 200-mile limit of the Atlantic off the coasts of North Carolina, South Carolina, Georgia and the east coast of Florida to Key West.*

Legislative Authority: When Congress passed Public Law 94-265, the **Magnuson Fishery Conservation and Management Act of 1976 (MFCMA)**, it extended the U.S. jurisdiction of fisheries out to 200 miles and created a new form of regional government through the eight regional fishery management councils. In 1996 the Sustainable Fisheries Act (SFA) became law and amended the Magnuson Act and changing the name to the Magnuson-Stevens Fishery Conservation and Management Act. Congress passed the SFA to protect marine fish stocks with requirements to prevent and stop overfishing, minimize bycatch, and protect habitat. On January 12, 2007, President Bush signed the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006. The new law is groundbreaking in several respects: it mandates the use of annual catch limits and accountability measures to end overfishing, provides for widespread market-based fishery management through limited access programs, and calls for increased international cooperation. For the latest information regarding the Reauthorization Act, visit: <http://www.nmfs.noaa.gov/msa2007/index.html>

Management Responsibilities: The role of the councils is to develop fishery management plans needed to manage fishery resources within the 200-mile EEZ. Outer boundaries of the EEZ off the southeastern coast vary according to areas where jurisdictional boundaries meet with Bermuda, the Bahamas, and Cuba. Through the Fishery Management Plan (FMP) for Coral, Coral Reefs and Live/Hard Bottom Habitat of the South Atlantic Region, the Council manages coral, coral reefs, and hard bottom habitats, including deepwater corals.

How the agency's rules are made: South Atlantic Fishery Management Council Members are citizens from each of these southeastern states who are knowledgeable of some aspects of the fisheries. They serve three-year terms and are appointed by the Secretary of Commerce from lists of nominees submitted by the governors of the states. Appointed members may serve a maximum of three consecutive terms. The official responsible for marine fisheries management in each state, and the regional director of the National Marine Fisheries Service are also voting members. Non-voting members include representatives of the U.S. Fish and Wildlife Service, U.S. Coast Guard, State Department, and Atlantic States Marine Fisheries Commission. Source: <http://www.safmc.net/AboutUs/AboutSAFMC/tabid/361/Default.aspx>

The Council meets four times each year, once in each of the southeastern states. Before final action on any proposed rule change is taken, the Council involves the public through informal public scoping meetings, public hearings and input at Council meetings. Proposed rule changes are then sent to NMFS for further review, public comment and approval before being implemented. In addition, the Council receives input and recommendations from

knowledgeable people from other state and federal agencies, universities, and members of the public who serve on various committees and panels. These include Advisory Panels, the Scientific & Statistical Committee, and Stock Assessment Panels.

Agency: Florida Department of Environmental Protection (DEP)

Mission: *The Florida Department of Environmental Protection protects, conserves and manages Florida's natural resources and enforces the State's environmental laws.*

Jurisdiction: State of Florida, including the Territorial Sea (three nautical miles from shore in the Atlantic Ocean, three leagues or nine nautical miles from shore in the Gulf of Mexico) and state-owned, sovereignty submerged lands.

Statutory Authority: The Florida DEP is a Cabinet level Department in the Executive branch of the Florida government. Statutory authority applicable to the southeast Florida coral reef vested in the DEP includes:

**Chapter 161 Beaches and Shore Preservation,
Chapter 253 State Lands,
Chapter 258 State Parks and Preserves,
Chapter 259 Land Acquisition for Conservation or Recreation,
Chapter 373 Water Resources,
Chapter 376 Pollutant Discharge Prevention and Removal,
Chapter 380 Land and Water Management,
Chapter 403 Environmental Control.**

http://www.dep.state.fl.us/cmp/publications/fcmp_guide_Feb_2012.pdf

Florida Coral Reef Protection Act of 2009

The Florida Coral Reef Protection Act authorizes the DEP, as the state's lead trustee for coral reef resources, to protect coral reefs through timely and efficient assessment and recovery of damages to coral reefs and to enter into delegation agreements with other state or local government agencies with coral reefs in their jurisdiction to carry out the intent of the act.

http://www.dep.state.fl.us/coastal/programs/coral/pub/Coral_Reef_Protection_Act_Q&A.pdf

Management Responsibilities: The DEP has diverse responsibilities including: environmental regulatory (wetland, water, air, waste), proprietary (state-owned lands), and management of Florida's state parks and aquatic preserves. DEP also co-manages the Florida Keys National Marine Sanctuary with the National Oceanic and Atmospheric Administration (NOAA). The Florida Coral Reef Conservation Program (CRCP) is housed in the DEP, Office of Coastal and Aquatic Managed Areas (CAMA). CAMA manages more than 4 million acres of the most valuable submerged lands and select coastal uplands in Florida. In addition to CRCP, CAMA manages 41 aquatic preserves and, in coordination with the NOAA, three National Estuarine Research Reserves and the Florida Keys National Marine Sanctuary. More information about the DEP is available at: <http://www.dep.state.fl.us/mainpage/programs/default.htm>

The DEP CRCP provides administrative, staffing, and funding support to coral reef conservation activities in the Florida Keys and southeast Florida region.

How the agency's rules are made: The Florida Administrative Procedure Act (Act) is found in Title 10, Part X, Chapter 120 of the Florida Statutes (F.S.). The Act describes how state agencies make rules and limits the scope of those rules to authorities provided by statute.

http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&URL=0100-0199/0120/0120.html

According to Section 120.525, F.S. an agency must give notice of all public meetings, hearings and workshops by publishing it in the Florida Administrative Weekly and on the agency's website at least seven days before the event. Section 120.55, F.S., requires the Department of State to publish the Florida Administrative Code (F.A.C.) on its website. The F.A.C. will contain all rules adopted by the each agency, all history notes, indexes to all rules, and all other materials required or authorized by law which will be useful to the department. Section 120.536, F.S. provides that an agency has authority only to adopt rules related to the powers and duties granted by the concerned statute. An agency cannot adopt a rule only because of the reason that it is reasonably related to the purpose of the concerned legislation. An agency does not have authority to execute statutory provisions related to general legislative intent or policy. Also according to Section 120.54, F.S., an agency cannot use discretion in rule making. It has to adopt the rule making procedures as soon as practicable.

Agency: NOAA Coral Reef Conservation Program

Mission: *The mission of the NOAA Coral Reef Conservation (CRCP) is to protect, conserve, and restore coral reef resources by maintaining healthy ecosystem function.*

Jurisdiction: Seven U.S. jurisdictions, including states, commonwealths, and territories.

Legislative and Executive Order Authority: NOAA's Coral Reef Conservation Program (CRCP) was established in 2000 to help fulfill NOAA's responsibilities under *The Coral Reef Conservation Act* and Presidential Executive Order 13089 on Coral Reef Protection. In addition, the CRCP works across NOAA line offices to implement coral reef conservation under following laws:

- *The Magnuson-Stevens Fishery Conservation and Management Act*
- The Lacey Act
- *The Endangered Species Act*
- *The Marine Mammal Protection Act*
- The Fish and Wildlife Coordination Act
- *The National Marine Sanctuaries Act*
- *The Coastal Zone Management Act*

Management Responsibilities: Domestically, the CRCP funds and equips coral reef conservation activities by NOAA and its partners in the seven U.S. states and jurisdictions containing coral reefs (American Samoa, the Commonwealth of the Northern Mariana Islands,

Florida, Guam, Hawai`i, Puerto Rico, and the U.S. Virgin Islands), uninhabited islands including the Northwestern Hawaiian Islands and the Pacific Remote Island Areas. To make the most of limited resources and to reverse the decline in coral reef health, the NOAA CRCP is focusing their efforts to address the top three recognized global threats to coral reef ecosystems: climate change impacts, fishing impacts, and impacts from land-based sources of pollution. Source: <http://coralreef.noaa.gov/aboutcrp/>

The program provides coral reef managers, scientists, and other users worldwide with information, including forecasts of coral bleaching events using sea surface temperature data from satellites. Citizens and government officials acting locally are partners in improving coral reef health globally. NOAA CRCP provides information that empowers public partners to act; for example, informative signs in coastal areas and distributing educational information to coastal businesses and the public. Between 2002 and 2009, NOAA awarded a total of over \$50 million in matching grants for coral conservation projects through their Coral Reef Conservation Grants Programs. The Coral Reef Conservation Fund, administered by the National Fish and Wildlife Foundation, builds public-private partnerships and leveraged NOAA's \$4.7 million into more than \$12 million for 140 projects in 28 countries.

How the agency's rules are made: The NOAA CRCP is a non-regulatory partnership of federal staff within various offices and programs of NOAA, including the National Ocean Service, National Marine Fisheries Service, and National Weather Service.

5 Types of Management for Reef Fish and Coral

Reefs

5.1 Introduction

A review of marine resource management in Florida has shown three types of management have been used to varying degrees: species-based management, activity-based management and place-based management. **Species-based management** addresses management needs on an individual species level. **Activity-based management** addresses human activities to reduce or prevent adverse effects from an activity to natural resources or to direct human activities in ways to reduce user conflicts. **Place-based management** addresses a broad range of management actions to protect specific locations, specific habitats or larger areas of important, connected habitats. **Ecosystem-based Management (EBM)** includes consideration of multiple factors such as pollution, coastal development, harvest pressure, predator/prey and other ecological interactions, and watershed management. Each type of management tool has benefits and costs specific to the management type. Successful management plans, such as the Florida Keys National Marine Sanctuary Revised Management Plan (NOAA 2007) usually incorporate a combination of these management approaches to balance natural resource protection with continued use of these resources.

5.2 Species-Based Management in Florida

Species-based management actions focus on one species, without regard to the ecological connections of that species within the ecosystem. This management approach is most effective where species diversity within a fishery is low (Pace 2004). However, species diversity within the Florida coral reef ecosystem reduces the effectiveness of species-based management actions. Bycatch, release mortality (Bartholomew and Bohnsack 2005), and misidentification of fish (resulting in harvest of fish during closed seasons or applying the incorrect size or bag limit) (FWC 2007a) contribute to reduce the effectiveness of fisheries management actions in Florida ecosystems. A look at the Florida saltwater fishing regulations or the South Atlantic Fishery Management Council's fishery regulations shows a complex array of size limits, bag limits, closed seasons, gear restrictions, and area restrictions. One reason for the abundance of fisheries regulations is because the South Atlantic and Florida state waters are home to a great diversity of marine fish species (FWC 2007b). Another reason for the intricacy of the regulations stems from the need for greater levels of protection to rebuild overfished stocks in both state and federal waters.

The state and federal stock assessment processes used for Florida reef fisheries share a common challenge: interconnected reef fish species are assessed individually. The Florida Fish and Wildlife Conservation Commission (FWC) manages fisheries in state waters, but has a strong interest in how fish are managed in federal waters and how that management affects Floridians. FWC staff serve on both the South Atlantic and Gulf of Mexico Fishery Management Councils

and coordinate with the Councils to improve fisheries management. The Councils and the FWC often enact consistent regulations in state and federal waters, but sometimes use different approaches to meet management goals. The FWC also partners with the Councils and NOAA Fisheries to collect fishery data, conduct research, assess fish stocks and enforce regulations. Source: <http://myfwc.com/fishing/saltwater/recreational/federal-waters/>

As noted in Ferro and others (2005), two legal size red grouper, no legal size gag, scamp or yellow fin grouper and no black or Goliath grouper were observed in 667 fish counts, over four years of sampling off Broward County, Florida. The low abundance and size of groupers in an area with abundant reef habitat shows that local assemblages of reef fish are affected by fishing pressure in southeast Florida. Broward County is home to a large human population with a long tradition of recreational, commercial and spear fishing. With the exceptions of Goliath and Nassau grouper (harvest is prohibited), these grouper species are managed with size and bag limits, as well as seasonal closures intended to prevent overfishing. The observations of Ferro and others (2005) illustrate the limitations of single-species fisheries management for local assemblages of reef fish under intense fishing pressure.

5.3 Activity-Based Management in Florida

Activity-based management focuses on changing human behavior or human use patterns to protect natural resources. Activity-based management options are often used to reduce adverse effects of human activities on marine and estuarine resources, habitats and ecosystems. Students of fisheries science are taught that “90% of fisheries management is people management”. This statement is particularly true of activity based management. Different sectors of the fishery have different activity based regulations. For example, gear restrictions for recreational (e.g. rod and reel fishing only), commercial (e.g. rod and reel, bandit reel, longline, trap and pot), and spear fishing are examples of activity-based fishery management. Each type of activity has specific regulations in Florida, designed to ensure sustainable fisheries resource use. Activity-based fisheries regulations are also used in attempts to limit the impacts of overfishing on a fish stock. There is often overlap between species-based and activity based management, as activities may be managed to protect species or groups of species that may be at risk from specific activities. Traditional fisheries management approaches usually use a combination of both species-based and activity-based management. Examples of both of these management approaches can be found at the following links:

Florida recreational fishing regulations
<http://myfwc.com/fishing/saltwater/recreational/>

Florida commercial fishing regulations
http://myfwc.com/media/2241671/Commercial_Regulations_2012_July-December.pdf

Florida spearfishing regulations-prohibited species and gear (powerheads),
<http://www.eregulations.com/florida/fishing/saltwater/spearfishing/>

South Atlantic Fishery Management Council recreational regulations
<http://www.safmc.net/LinkClick.aspx?fileticket=8YGt8yQfrd4%3d&tabid=248>

South Atlantic Fishery Management Council commercial fishing regulations
<http://www.safmc.net/LinkClick.aspx?fileticket=8skU47W%2fX4c%3d&tabid=248>

Activities such as anchoring and vessel groundings have resulted in extensive adverse impacts to Florida's Reef Tract (NOAA 2007, Collier 2011). Public reaction to these impacts resulted in activity-based management actions, such as delineation of an "Area to be Avoided" for ships larger than 100m in length in the Florida Keys and revision of the Port Everglades anchorage in southeast Florida. Examples of activity-based coral reef management in southeast Florida include the Florida Coral Reef Protection Act, mooring buoy programs, and evaluation and modification of commercial ship anchorages.

The Florida Coral Reef Protection Act prohibits anchoring on coral reefs and authorizes the DEP to collect penalties for impacts to coral reefs resulting from anchoring and grounding. The Florida Coral Reef Protection Act can be found at:
http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0400-0499/0403/Sections/0403.93345.html

The Port Everglades anchorage off Broward County, Florida was revised with input from SEFCRI partner agencies and academics in 2008 to reduce ship anchoring and grounding impacts on coral reefs (Collier 2011). In response to 11 large ship groundings in a 12-year period and 6 anchor drag incidents in two years off Port Everglades, an evaluation of the anchorage was conducted by SEFCRI partners with recommendations being made to the U.S. Coast Guard, which is the agency that designates port anchorages. The anchorages at Miami and Palm Beach were studied by researchers at Nova Southeastern University, in 2010, to determine if revisions were needed to protect coral reef resources within those anchorages. No modifications to the Port of Palm Beach are recommended. Modifications to the Port of Miami anchorage are still being considered to reduce ship anchoring impacts to coral reefs within that anchorage.

5.4 Place-Based Natural Resource Management

Place-based management actions focus on protecting natural resources, habitats, or ecologically significant areas with discrete geographic boundaries. Place-based natural resource management includes designations such as parks, preserves, sanctuaries, protected areas, and use zoning. The use of place-based management is common in terrestrial systems, such as national parks, state parks, and wildlife refuges. Place-based natural resource management has occurred in Florida since 1935, when the first four state parks were originally designated (Source: <http://www.floridastateparks.org/history/ccc.cfm>). A number of place-based natural resource management options have been used in Florida in terrestrial and marine systems including state parks, aquatic preserves, and Outstanding Florida Waters. Federal place-based designations in Florida include National Parks, the Florida Keys National Marine Sanctuary and designated Marine Protected Areas.

5.4.1 Florida's State Parks

The Florida Park Service is one of the largest in the country with 160 parks spanning 700,000 acres and 100 miles of sandy white beach. Florida's state park system includes both terrestrial and marine parks. John Pennekamp State Park was the first place-based management option to protect coral reef and other marine habitats by managing human uses of reef and fish resources. St. Lucie Inlet Preserve State Park in Stuart is the only state park within the SEFCRI region that includes coral and worm reefs. The boundaries of this state park extend up to 1 mile offshore. Other state parks that are located on the beachfront, but do not include submerged ocean bottom are Bill Baggs Cape Florida State Park on Key Biscayne, John U. Lloyd Beach State Park in Dania Beach, and John D. MacArthur State Park in North Palm Beach.

Source: <http://www.dep.state.fl.us/parks/>

5.4.2 Aquatic Preserves

Aquatic Preserves are a state-level, place-based management designation intended to protect water quality and important aquatic habitats. Designations and protections for Aquatic Preserves are made in Chapter 18-18, F.A.C. (Biscayne Bay Aquatic Preserve and Chapter 18-20, F.A.C. (all other Aquatic Preserves). Today, Florida is fortunate to have 41 aquatic preserves, encompassing approximately 2.2 million acres. Approximately two-thirds of Floridians live in counties that border an aquatic preserve. All but four of these aquatic preserves are located along Florida's 8,400 miles of coastline in the shallow waters of marshes and estuaries. Aquatic preserves protect the living waters of Florida to ensure that they will always be home for bird rookeries and fish while protecting freshwater springs, salt marshes, seagrass meadows and mangrove forests. The Aquatic Preserve Act also acknowledged that these waters are critical nurseries for fish and other aquatic life. A portion of the Biscayne Bay Aquatic Preserve extends into the Atlantic Ocean, and includes hardbottom resources.

Source: <http://www.dep.state.fl.us/coastal/programs/aquatic.htm>

5.4.3 Outstanding Florida Waters

Outstanding Florida Waters (OFW) are another state-level place-based designation. OFWs are designated in Chapter 62-302, F.A.C. to provide special protection for a water body because of its natural attributes. This special designation is applied to certain waters, and is intended to protect existing good water quality. Most OFWs are areas managed by the state or federal government as parks, including wildlife refuges, preserves, marine sanctuaries, estuarine research reserves, certain waters within state or national forests, scenic and wild rivers, or aquatic preserves. Generally, the waters within these managed areas are OFWs because the managing agency has requested this special protection.

Waters that are not already in a state or federal managed area, may be designated as "special water" OFWs if certain requirements are met including a public process of designation (62-302.700 F.A.C.). All waters of the state fall into one of five surface water classifications (62-302.400 F.A.C.) with specific criteria applicable to each class of water. In addition to its surface water classification, a water may be designated as an OFW, (62-302.700 F.A.C.). For more information, see: <http://www.dep.state.fl.us/water/wqssp/ofw.htm>

5.4.4 National Park Service

Examples of place-based natural resource management at the federal level in Florida include National Parks, marine protected areas, and habitat areas of particular concern designated by the South Atlantic Fishery Management Council, Biscayne National Park, Dry Tortugas National Park, and the Florida Keys National Marine Sanctuary. The U.S. Department of Interior, National Park Service manages 11 national parks in Florida, including two with coral reef habitats, the Dry Tortugas National Park and Biscayne National Park. Although these parks are not located within the SEFCRI region, they are located along the Florida Reef Tract and are interconnected with coral reefs in southeast Florida.

5.4.5 Florida Keys National Marine Sanctuary

Place-based management strategies have been used in the Florida Keys National Marine Sanctuary for over two decades to balance fishing, diving and snorkeling uses with the need to protect and conserve important marine habitats. Ecological Reserves, Existing Management Areas, Sanctuary Preserve Areas, Special Use Areas, and Wildlife Management Areas are various types of marine zones, one of many management tools used in the FKNMS. These management tools are currently undergoing a programmatic level review in the FKNMS.

Source: <http://floridakeys.noaa.gov/zones/types.html>

Ecological Reserves are the largest of the sanctuary zones and are able to protect an entire range of marine habitats found in Florida Keys National Marine Sanctuary. Ecological Reserves within Florida Keys National Marine Sanctuary include: Tortugas Ecological Reserve and Western Sambo Ecological Reserve. Examples of prohibitions in ecological reserves include discharging any matter, any type of fishing, diving and snorkeling, touching or standing on coral, anchoring on live or dead coral. Aside from prohibitions, other management actions include requiring use of mooring buoys and requiring access permits for activities within ecological reserves.

Existing Management Areas are areas within Florida Keys National Marine Sanctuary that were established by other agencies prior to 1997 when sanctuary zoning regulations went into effect. Existing Management Areas within Florida Keys National Marine Sanctuary include: John Pennekamp Coral Reef State Park, Great White Heron National Wildlife Refuge, Key Largo Existing Management Area, Key West National Wildlife Refuge, and Looe Key Existing Management Area.

Sanctuary Preservation Areas (SPAs) within Florida Keys National Marine Sanctuary reduce user conflict between snorkeler, divers and fishers and protect shallow reefs along the reef tract from extractive uses (e.g. fishing, lobstering, and marine life collecting). SPAs encompass discrete, biologically important areas that help sustain critical marine species and habitats. SPAs within Florida Keys National Marine Sanctuary include: Alligator Reef SPA, Carysfort SPA, Cheeca Rocks SPA, Coffins Patch SPA, Conch Reef SPA, Eastern Dry Rocks SPA, The Elbow SPA, French Reef SPA, Grecian Rocks SPA, Hen and Chickens SPA, Key Largo Dry Rocks SPA, Looe Key SPA, Molasses Reef SPA, Newfound Harbor Key SPA, Sand Key SPA, Rock Key SPA, and Sombrero Key SPA.

Special-Use Areas are used to set aside areas for scientific research and educational purposes, restoration, monitoring, or to establish areas that confine or restrict activities. Special-use Areas within Florida Keys National Marine Sanctuary include: Conch Reef Research Only Area, Eastern Sambo Research Only Area, Looe Key Research Only Area, and Tennessee Reef Research Only Area.

Wildlife Management Areas are intended to minimize disturbance to sensitive or endangered wildlife and their habitats, such as bird nesting, resting or feeding areas, and turtle nesting beaches. Regulations governing WMAs are designed to provide opportunities for public use while protecting wildlife. These areas often include no-motor zones, idle speed only/no wake zones, and buffer and closed zones.

5.4.6 Marine Protected Areas

The South Atlantic Fishery Management Council has authority under the Magnuson-Stevens Sustainable Fisheries Act to designate Marine Protected Areas within its jurisdiction. A **Marine Protected Area (MPA)**, as defined in Presidential Executive Order 13158 in 2000, is any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. The South Atlantic Council further defines MPAs within its jurisdiction as a network of specific areas of marine environments reserved and managed for the primary purpose of aiding in the recovery of overfished stocks and to ensure the persistence of healthy fish stocks, fisheries, and associated habitats. Such areas may include naturally occurring or artificial bottom and water column habitats, and may include prohibition of harvest on seasonal or permanent time periods to achieve desired fishery conservation and management goals.

5.4.7 Spatial Scale of Place-based Management

The designations for marine zones in the FKNMS, described above, highlight the importance of spatial scale when considering place-based marine resource management options. Some designations include discrete marine habitats like the Sanctuary Preserve Areas, while other designations, like the Ecological Reserve, protect a large expanse of waters that include a mosaic of marine habitats, from shallow patch reefs, across the shelf to deep reefs. Spatial scale is a critical consideration for any place-based management option being considered. Any place-based management option must be large enough to address the management need, while balancing the effects of the management option on resource users.

5.5 Ecosystem-based Management

Ecosystem-based management (EBM) has evolved from a vague principle to a central paradigm underlying living marine resource policy in the United States (Levin et al. 2009). The traditional management strategy for fisheries and other living resources has been to focus on one species of fish and shellfish in isolation (NOAA 2012). For example, if there were a decline in the number of a certain kind of fish, managers might decide to decrease the number of that species that could be removed by fishing in a given year. The problem with this approach is that the impact of fishing on a single species is only one variable that affects the health of its population (NOAA

2012). EBM differs from conventional resource management in that it defines management strategies for entire systems, not simply individual components of the ecosystem (Levin et al. 2009). Additional elements come in to play, such as interactions with other species, proximity of other habitats and the effects of pollution and other stresses on habitat and water quality (NOAA 2012). In order to more effectively assess the health of a fishery and to determine the best way to maintain it, the entire ecosystem must be taken into account (NOAA 2012). Importantly, EBM considers humans as an integral part of the ecosystem, since humans derive a variety of services from the ecosystem and also influence ecosystem processes (Levin et al. 2009). A key aspect of EBM, that is particularly important to reef-fisheries, is illuminating trade-offs among ecosystem services and management goals (Levin et al. 2009, McClanahan et al. 2011)

As described in NOAA (2012), an ecosystem is a geographically specified system of organisms (including humans), the environment, and the processes that control its dynamics. Ecosystem approaches to management use integrated approaches to study and manage the resources of an entire ecosystem. This approach considers the cumulative impacts from various sources and the balance of conflicting uses.

“NOAA is taking an ecosystem approach to management that is:

- Adaptive: Collaboratively developed management strategies are tailored to unique conditions and issues, and strategies are adapted and combined for an integrated approach.
- Collaborative and voluntary: Mechanisms are in place to share information and receive feedback from others, and stakeholders are included in decision making within joint strategies.
- Incremental: Ecosystem-scale information is improving as techniques and tools are developed in research, observations, forecasting, and management.
- Regionally directed: A joint strategy plan with stakeholders is based on NOAA’s 10 regional ecosystems to meet desired ecosystem productivity and benefits.
- Adaptable given ecosystem knowledge and uncertainty: Our marine resources are complex and dynamic; ecosystem approaches to management recognize that individual resources are better managed by addressing ecosystem components and processes while looking at cumulative impacts.
- Inclusive of multiple external influences: Ecosystem approaches to management encourage decisions based on environmental, social, and political factors.” (NOAA 2012)

5.5.1 Ecosystem-Based Management in the South Atlantic Region

The South Atlantic Fishery Management Council (SAFMC) has implemented ecosystem-based principles through existing fishery management actions including establishment of deepwater Marine Protected Areas for the Snapper Grouper fishery, proactive harvest control rules on species not overfished (e.g., dolphin and wahoo), extensive gear/area closures that in most cases eliminate the impact of fishing gear on Essential Fish Habitat (EFH), and Special Management Zones (SAFMC 2009). The Council is taking an ecosystem approach to protect deepwater ecosystems while providing for traditional fisheries for golden crab and royal red shrimp in areas where they do not impact deepwater coral habitat. The Council’s stakeholder-based process taps

an extensive network of scientific, management, and fishery professionals within the region, and the Council has invested significantly in tools to maintain this engagement over the long term.

Mechanisms exist in the Coral FMP, as amended, to further protect deepwater coral and live/hard bottom habitats (SAFMC 2009). The Council's Habitat and Environmental Protection Advisory Panel and Coral Advisory Panel have supported proactive efforts to identify and protect deepwater coral ecosystems in the South Atlantic region. Management actions have included the establishment of deepwater coral Habitat Areas of Particular Concern (C-HAPCs) to protect over 23,000 square miles of habitat that is thought to be the largest continuous distribution of pristine deepwater coral ecosystems in the world (SAFMC 2009).

5.5.2 Oculina Bank Habitat Area of Particular Concern (HAPC) and Experimental Closed Area

Ivory tree coral, (*Oculina varicosa*), is distributed along the South Atlantic shelf with concentrations occurring off the central East Coast of Florida. This fragile branching coral provides essential habitat to a complex of fish species including those managed under the Snapper Grouper Fishery Management Plan (SAFMC 2009). Roller rig trawling (large, heavy nets towed by a fishing boat that use rollers on the front of the trawl to guide the net over obstructions like coral reefs) was used to harvest reef fish and shrimp on the Oculina Bank, soon after these coral structures were discovered. The Oculina Bank, located approximately 15 nautical miles off the coast of Ft. Pierce, Florida has since been designated a Habitat Area of Particular Concern (HAPC) by the South Atlantic Fishery Management Council. Fishing gear restrictions, such as prohibitions on trawling, bottom longline and bottom hook and line are in place within the Experimental Closed Area in order to protect Oculina coral found in the area (SAFMC 2009).

5.5.3 Deepwater Coral Habitat Areas of Particular Concern (HAPC)

In response to research revealing the importance and uniqueness of deepwater coral habitats in the South Atlantic, along with new reports prepared for the Council by researchers, the Council decided to approve HAPC designation for six deepwater coral areas to extend them a higher level of protection from fishing related impacts (SAFMC 2009). The Council's Habitat and Coral Advisory Panels proposed these areas at the October 2004 meeting and the Council approved the proposal at their December 2004 meeting. Management measures proposed by the SAFMC to help protect these sensitive habitats received approval from NOAA Fisheries Service and the Secretary of Commerce and became effective July 22, 2010. Five areas, located off the southeastern coast of the U.S. and encompassing more than 23,000 square miles have been designated Coral Habitat Areas of Particular Concern. The designation affords added protection from fishing related impacts to the areas that house an invaluable array of fish and invertebrate species.

5.6 Conclusions

The Florida LAS projects and other work have provided important baseline information and laid the foundation for implementing a coordinated management plan for coral reefs and reef fish in the SEFCRI region that will be based on stakeholder-recommended management actions. These stakeholder recommendations may include a combination of species-based management to address issues with individual species, activity-based management to reduce impacts of human activities on marine resources, place-based management to protect fisheries and coral reef habitats that have higher biological (e.g., spawning aggregation sites) or ecological importance (e.g., specific habitats that are rare or threatened by human activities), and ecosystem-based management to include consideration of ecosystem-scale environmental conditions and human dimensions in the ecosystem. The Management Options Identification Process is next step for engaging stakeholders, such as fishers, divers, tourism and development professionals and others, to advance a coordinated management plan for the southeast Florida coral reef ecosystem.

Each type of management approach requires funding, and must consider compliance with and enforcement of management actions. Stakeholder engagement in the development, implementation and enforcement of management actions is critical to the success of this management initiative. While SEFCRI partner agencies and organizations have leveraged the LAS projects with other important work to move toward a coordinated management plan for the southeast portion of the Florida Reef Tract, the partners have recognized that they cannot develop and implement an effective management plan without the participation of the people affected by such a plan.

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Holocene Coral-Reef Development. With the continuing threat of climate change and other anthropogenic disturbances, the future of Florida's coral reefs is uncertain. One way to gain insights into the future trajectories of Florida's coral reefs is to investigate how they responded to environmental disturbances in the past. Previous Research. Ecosystem-wide study of seafloor erosion, changing coastal water depths, and effects on coastal storm and wave impacts along the Florida Keys Coral Reef Tract in South Florida. Contacts: Julie Richey, Ph.D., Jennifer A Flannery. Attribution: St. Petersburg Coastal and Marine Science Center. Two ongoing southeast Florida reef monitoring efforts, the Broward County Marine Biological Monitoring Program and the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP), record coral disease presence. Details on both monitoring programs and the results of their work can be found later in this chapter. income generated for the region. The additional high use of coral reefs by residents of southeast Florida is explained by the fact that they lie adjacent to three of the four most populous counties in Florida (U.S. Census Bureau, 2007a), and >20% of all 2005-2006 state recreational saltwater fishing licenses were purchased by residents within these counties. Marine protected areas Management options Climate change Coral reef ecosystems. Introduction. Human impacts have degraded marine ecosystems primarily through overexploitation and destructive fishing practices, pollution, and climate change. Overfishing and pollution have long histories (Jackson and others 2001; Lotze and others 2006; Roberts 2007), and presumably lower the resistance and resilience of marine ecosystems to further impacts from climate change. Comprehensive recommendations have been made for improving ocean policy in light of these threats (POC 2003; USCOP 2004) and for mitigati