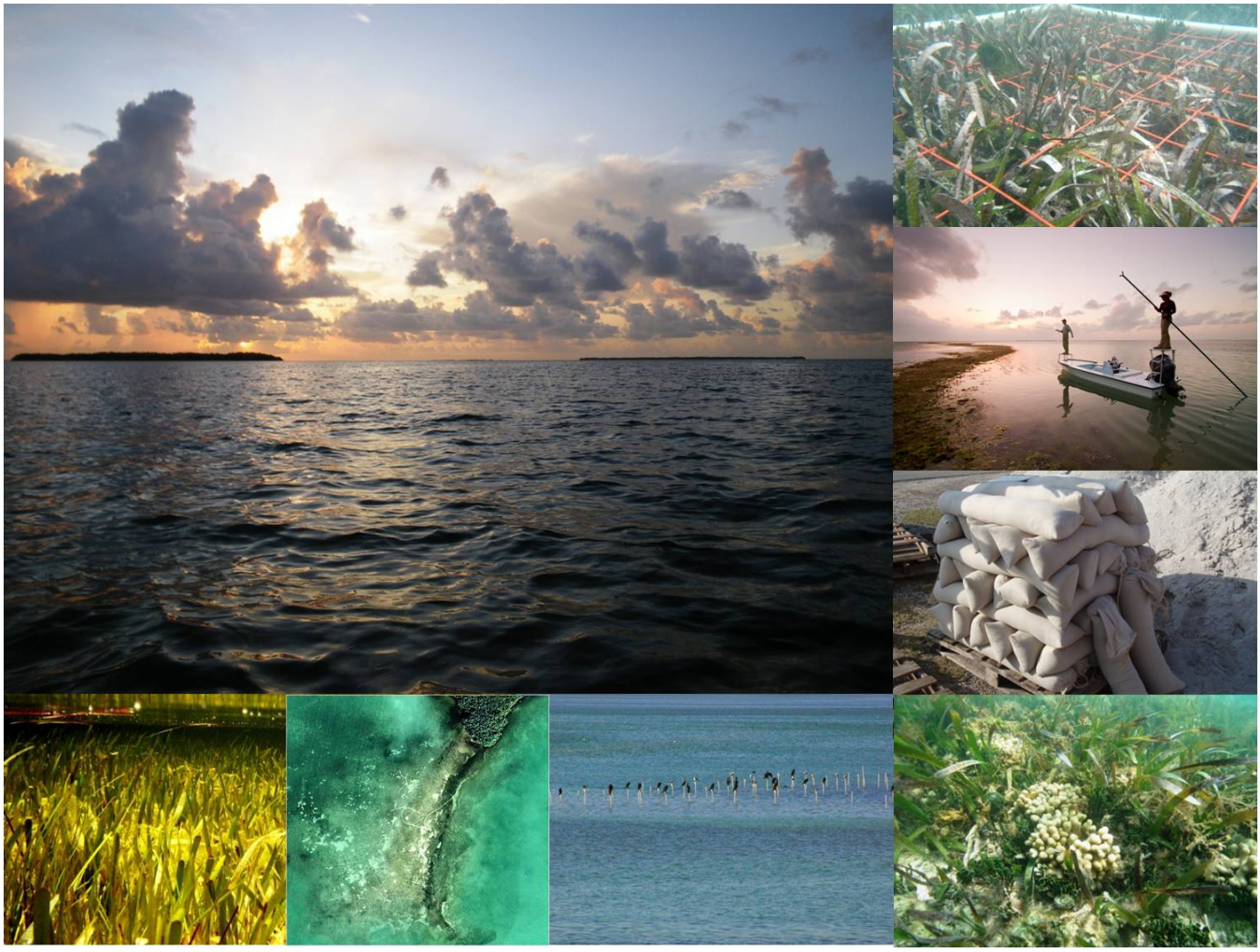
Florida Bay, Everglades National Park

Draft Seagrass Habitat Restoration Management Plan

August 2013



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August 2013

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for:

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U.S. Department of the Interior
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LIST OF ABBREVIATIONS

ARPA	Archaeological Resource Protection Act
ASMIS	Archaeological Site Information Management Information System
B-B	Braun-Blanquet
BMP	Best Management Practice
CE	Categorical Exclusion
CEPP	Central Everglades Planning Project
CEQ	Council on Environmental Quality
CERP	Comprehensive Everglades Restoration Plan
CFR	Code of Federal Regulations
CZMA	Coastal Zone Management Act
DAR	Damage Assessment Report
DARRP	Damage Assessment, Remediation, and Restoration Program
DGPS	Differential Global Positioning System
DM	Department of the Interior Manual
DOI	Department of the Interior
EFH	Essential Fish Habitat
ENP	Everglades National Park
ERDAR	Environmental Response, Damage Assessment, and Restoration
ERP	Environmental Resource Permit
ESA	Endangered Species Act
ESF	Environmental Screening Form
ESRI	Environmental Systems Research Institute
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
FHAP	Fisheries Habitat Assessment Program
FKNMS	Florida Keys National Marine Sanctuary
GMP	General Management Plan
GOMR	Gulf of Mexico Region
HAPC	Habitat Areas of Particular Concern
HEA	Habitat Equivalency Analysis
IDT	Interdisciplinary Team
IRR	Initial Response Report
MCPERD	Monroe County Planning and Environmental Resources Department
MRA	Minimum Requirements Analysis
MSD	Marjory Stoneman Douglas
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service

NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWP	Nationwide Permit
NWSC	National Wildlife Steering Committee
PEPC	Planning, Environment, and Public Comment
PSRPA	Park System Resource Protection Act
PTZ	Pole and Troll Zone
PU	Planting Unit
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RPCD	Resource Planning and Compliance Division
RPRS	Research Permit and Reporting System
SAV	Submerged Aquatic Vegetation
SEAC	Southeast Archeological Center
SFNRC	South Florida Natural Resource Center
SFWMD	South Florida Water Management District
SHPO	State Historic Preservation Office
SHRMP	Seagrass Habitat Restoration Management Plan
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
WMP	Wilderness Management Plan
WSP	Wilderness Stewardship Plan

EXECUTIVE SUMMARY

Florida Bay is a key ecological resource both for Everglades National Park (ENP) and the wider area, including the Florida Keys and Gulf of Mexico, providing services to the natural environment, the south Florida economy, and human recreation. Public use of Florida Bay for fishing and boating has resulted in widespread damage to the bay's key resource, its extensive seagrass beds, from motorized vessel groundings and propeller (prop) scarring. Damage to seagrass beds not only causes a direct and localized loss of ecosystem resources, but severe and/or repetitive damage can result in the deterioration of a larger area and subsequent impacts to water quality, wildlife, and fisheries. Additionally, Florida Bay is included within ENP's Marjory Stoneman Douglas (MSD) Wilderness Area, which under terms of its designation is to be managed to preserve wilderness character. The wilderness status of Florida Bay and its rich ecosystem resources require that damage assessment and restoration efforts be carefully considered and executed to ensure administrative necessity and minimum requirements pursuant to the Wilderness Act, while restoring ecosystem function and services.

The primary management challenges within Florida Bay are associated with the shallow depths found within large areas of the bay and allowing for recreational fishing and wildlife viewing opportunities, which can result in damages to the shallow benthic habitats from motorized watercraft. Recent studies have clearly demonstrated that prop scarring in Florida Bay is a widespread problem warranting new management strategies. The Preferred Alternative identified in the March 2013 Draft General Management Plan (GMP) will aim to support restoration of natural systems within ENP, while concurrently improving the quality and opportunities for park visitors. The Preferred Alternative includes establishment of a formal, comprehensive seagrass restoration program for Florida Bay, in conjunction with the proposed establishment of pole and troll zones in shallow areas to aid in reducing prop scarring and vessel groundings. This Seagrass Habitat Restoration Management Plan (SHRMP) for Florida Bay serves as a comprehensive and adaptive plan for assessing, restoring, and monitoring vessel-induced damages to seagrasses. It is consistent with, and part of, previously approved National Environmental Policy Act (NEPA) compliance documents and qualifies as a Categorical Exclusion (CE) with respect to NEPA pursuant to Department of the Interior Manual (516 DM, 12, section 12.5.E, *Actions Related to Resource Management and Protection*). This SHRMP was developed to provide technical guidance for ENP staff and managers and it is consistent with all applicable laws, regulations, and policies, and incorporates the most current scientific data on Florida Bay's ecosystem and seagrasses. This SHRMP provides a concise, consistent, adaptable, and easily applied process for:

- Evaluating seagrass damage;
- Determining the appropriate restoration action;
- Determining the required permits and compliance/regulatory review;
- Implementing restoration; and

- Evaluating recovery progress.

The SHRMP presents a Damage Assessment Decision Protocol specifying the process and requirements for incident reporting, personnel, and equipment, as well as the areas of expertise needed for assessments, data collection and management, and damage recovery modeling. This process will include contingencies for situations such as vessel removal or discovery of cultural resources at a damage site. The SHRMP presents a suite of restoration options with their appropriate uses, covering a range of damage levels from prop scarring to blow holes. Restoration options presented include sediment placement, seagrass transplantation, bird stakes/fertilizer spikes, no active restoration (monitoring only), and management options such as sign installation and temporary area closures. Restoration tasks that may be handled by outside partnerships or volunteers are identified. The discussion of restoration methods includes permitting requirements and necessary measures for minimizing impacts to wilderness character and wildlife. Post-restoration monitoring events will assess the progress of the restoration effort over a period of time and allow the resource manager to add to or modify restoration efforts. A preliminary list of candidate "priority areas" for initial restoration efforts has been identified, and a description of the public involvement and review process for this planning document is provided.

Comments on this *Draft Seagrass Habitat Restoration Management Plan* are welcome and will be accepted for 45 days after its release (comment period is August 20 – October 4, 2013). During the comment period, comments may be submitted by any of the following methods:

1) **On-line:** at http://parkplanning.nps.gov - select Everglades National Park

   This is the preferred method for submitting comments. An electronic public comment form is provided through this website.

2) **Mail:** Everglades National Park
   Attn: Fred Herling (Florida Bay Seagrass Plan)
   40001 State Road 9336
   Homestead, FL 33034-6733

Note: Before including your address, telephone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. Although you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

It should be noted that this Draft SHRMP document contains numerous references to the March 2013 Draft GMP/East Everglades Wilderness Study/Environmental Impact Statement (hereafter referred to as the March 2013 Draft GMP) and its Preferred Alternative. The Draft GMP is currently under revision subsequent to a public review/comment process. The Final GMP will contain some changes to the management of Florida Bay from what was presented in the Draft

GMP. Thus, some elements of the Final SHRMP document will be updated to reflect these changes.

1.0 INTRODUCTION

1.1 FLORIDA BAY AND EVERGLADES NATIONAL PARK

1.1.1 General Park History

Congress authorized the formation of Everglades National Park (ENP) on May 30, 1934. Thirteen years later (December 6, 1947), ENP was officially established with a dedication by President Harry S. Truman. At that time, ENP was comprised of 460,000 acres. Over time, park lands within ENP were acquired via public or private donations. By 1958, the boundaries of ENP had expanded to include approximately 1.4 million acres. In 1989, the ENP Protection and Expansion Act of 1989 added 109,506 acres to the ENP. Currently, ENP includes 6,070 km^2 (1,509,000 acres) (NPCA 2005, NPS SFNRC 2008, NPS 2013a).

1.1.2 Geographical Location

Located on the southern tip of the Florida peninsula, ENP is the third largest national park in the contiguous United States and contains the Marjory Stoneman Douglas (MSD) Wilderness Area, which is the largest subtropical wilderness in North America (~1,296,600 acres) (NPS 2013a, NPS SFNRC 2008). ENP has been designated as a World Heritage Site, an International Biosphere Reserve, and a Wetland of International Significance by the United Nations (NPS General Management Plan Newsletter One). Figure 1 shows the boundaries of ENP and the MSD Wilderness Area. The coastal receiving waters of the Everglades watershed are Florida Bay to the south and the Gulf of Mexico to the southwest (Lodge 2005).

Florida Bay is a triangular, estuarine lagoon encompassing ~2,200 km^2 (~550,000 acres) (NPS SFNRC 2012). The shallow depth of Florida Bay is one of its defining features, with water depths averaging 1-1.5 m (3-5 ft.) (Schomer and Drew 1982, Atkins 2011). Florida Bay is bounded by the Florida mainland to the north, the Florida Keys to the east and south, and the open waters of the Gulf of Mexico Region (GOMR) to the west (Figure 1).

The waters and substrate of Florida Bay fall under two authorities. The majority (~80%) of Florida Bay (~1,800 km^2) lies within the boundaries of ENP, under jurisdiction of the National Park Service (NPS), and the remaining area (~400 km^2) is included within the Florida Keys National Marine Sanctuary (FKNMS), which is under jurisdiction of the National Oceanic and Atmospheric Administration (NOAA) (NPCA 2005, Rudnick et al. 2005). Figure 1 depicts the boundaries of Florida Bay, ENP, and the FKNMS. The western boundary between Florida Bay and the GOMR is not clearly defined, although it roughly corresponds with the edge of ENP jurisdiction between Cape Sable and Long Key.

Figure 1. Location Map showing the boundaries of Florida Bay, Everglades National Park, Florida Keys National Marine Sanctuary, and the Marjory Stoneman Douglas Wilderness Area. Data provided by ENP.

1.1.3 Topography

1.1.3.1 Florida Bay Topography

Florida Bay contains a mosaic of varied soft-sediment and hardbottom communities (Chiappone and Sullivan 1994). The interior of Florida Bay is occupied by mangrove islands, carbonate mud banks, mud flats, and shallow basins (commonly termed "lakes") (RECOVER 2010, Madden et al. 2009). Figures 2-4 depict these features. Florida Bay was historically an estuarine lagoon with freshwater inputs from the Everglades watershed and marine connections to the Atlantic Ocean and GOMR; however, anthropogenic alterations of freshwater flows though the Everglades and seawater exchange through the Florida Keys (including construction of the Flagler Railroad) have transformed Florida Bay into a marine lagoon (Chiappone and Sullivan 1994, Rudnick et al. 2005). The presence of the banks in the western portion of Florida Bay allows for only limited water exchange between the Florida Bay and the GOMR (Smith 1994, Wang et al. 1994, NPS SFNRC 2012). The passes in the Florida Keys allow for water exchanges between the eastern and southern Florida Bay and the Atlantic Ocean (RECOVER 2010). The shallow depths of Florida Bay (Figure 5) allow for sufficient light penetration to support photosynthesis in the vast majority of the bay (Kelble et al. 2005). For this reason, seagrass beds are the dominant benthic community within Florida Bay (Figure 2, RECOVER 2010).

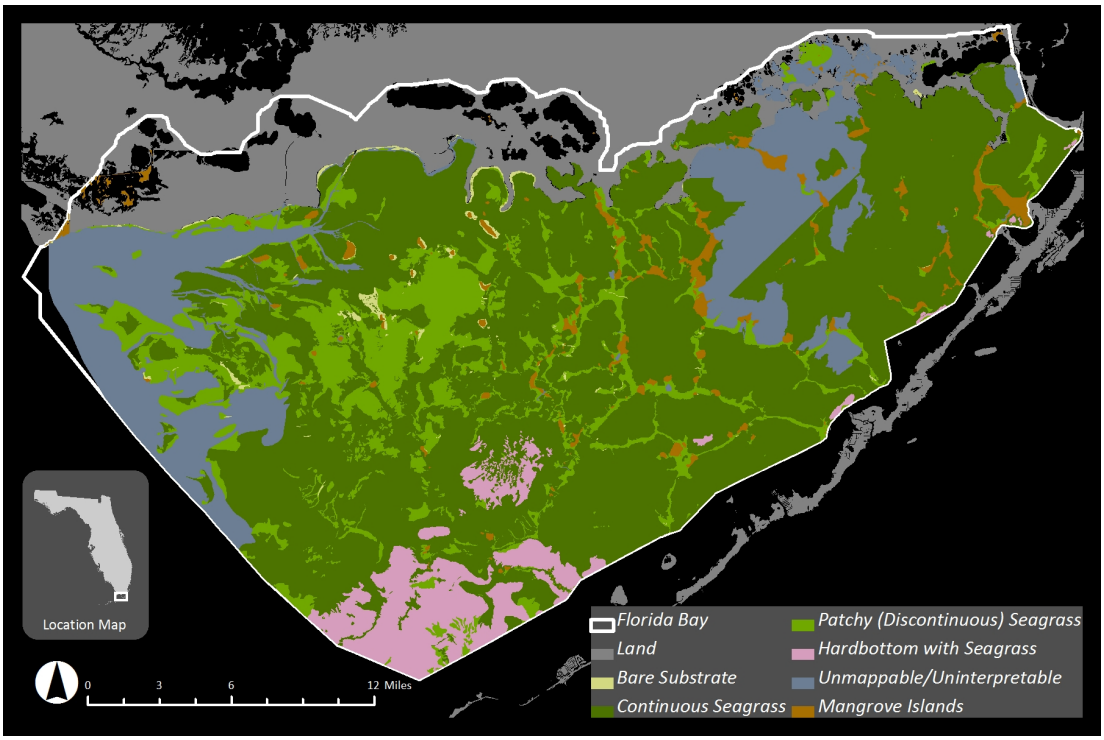

Figure 2. Florida Bay habitats. Data from FFWCC-FWRI 2001.

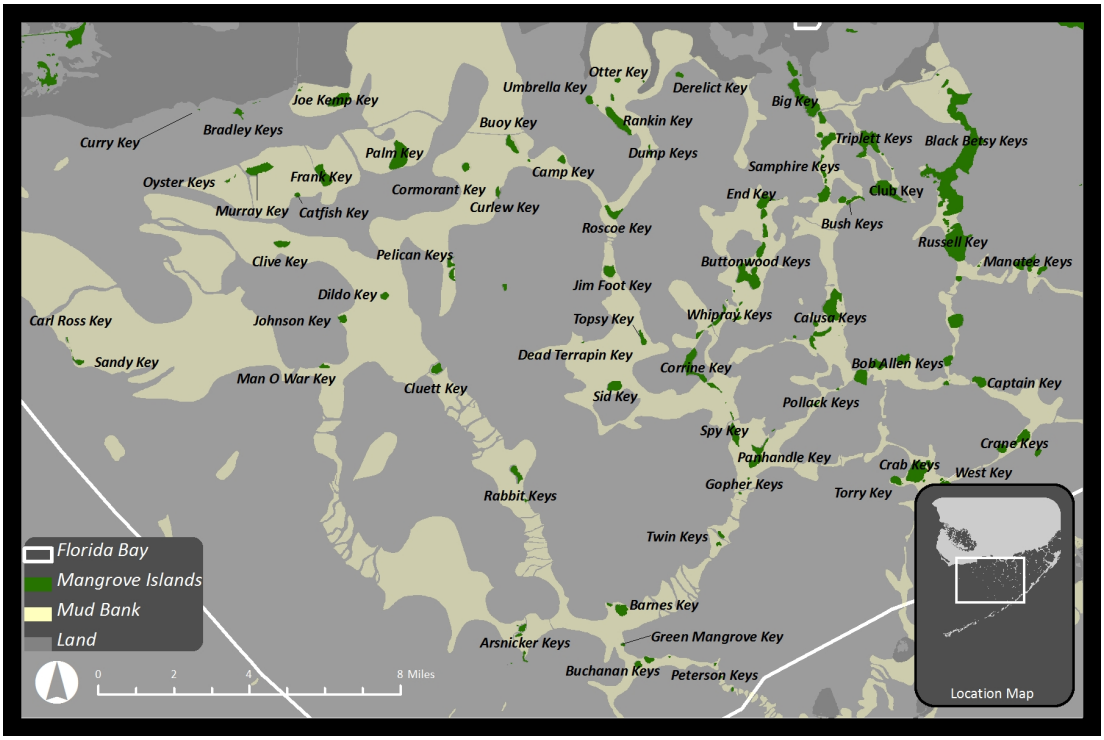

Figure 3. Mangrove islands and mud banks in western and central Florida Bay. Data from USGS 1997.

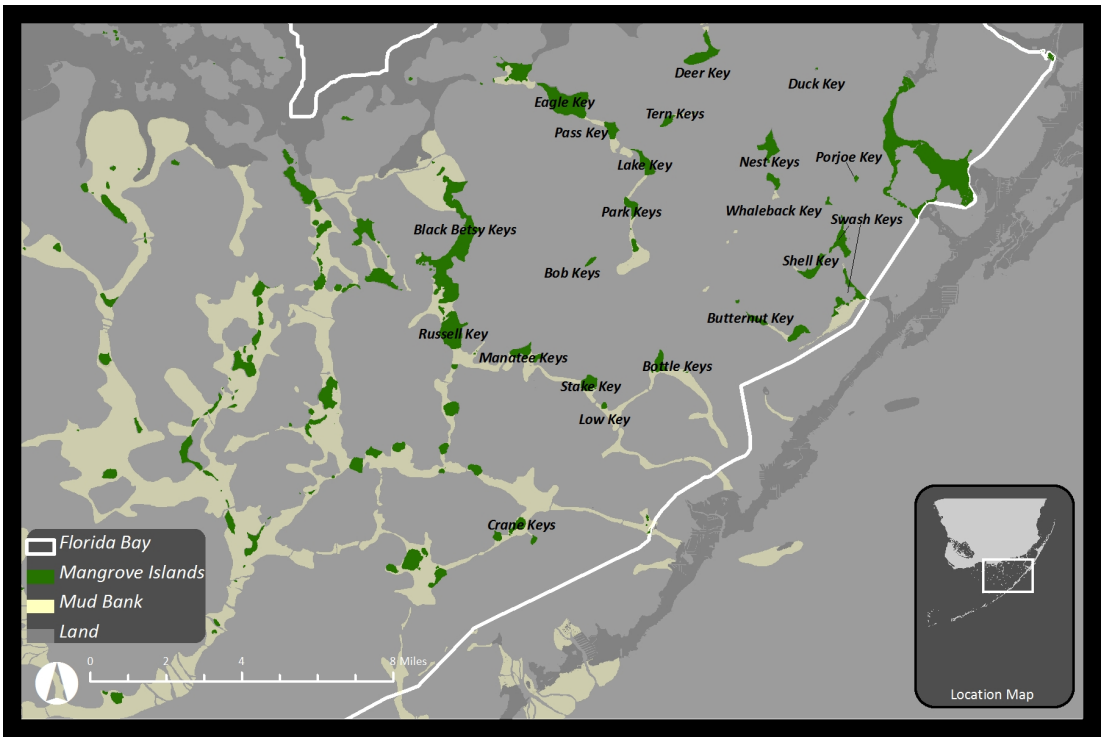

Figure 4. Mangrove islands and mud banks in eastern Florida Bay. Data from USGS 1997.

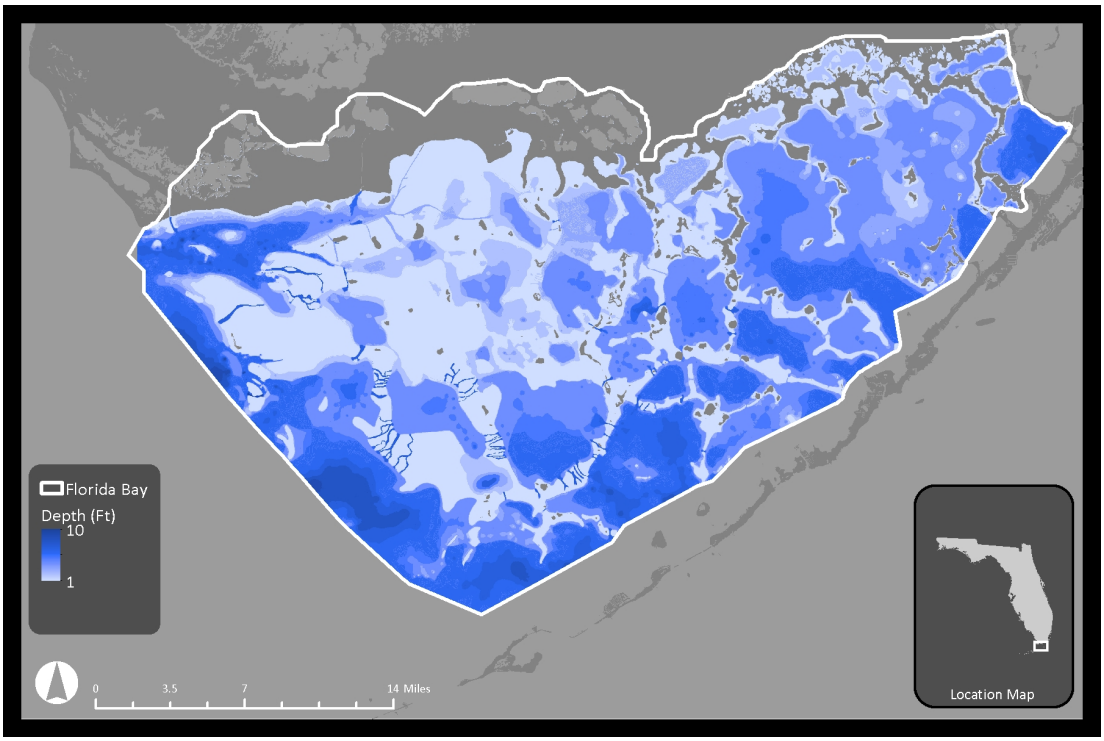

Figure 5. Bathymetry of Florida Bay. Data from FIU/USGS (input contours and banks), NIMA (input contours, banks, depth soundings), and ENP (interpolation/final dataset).

Florida Bay contains 237 low-lying muddy islands with areas > 100 m^2, which together comprise ~1.7% of the area of Florida Bay (Figures 3 and 4, Enos 1989). These islands were historically freshwater swamp bay heads that have been rising with the sea level over the past 5,000 years (NPS 1979). As shown in Figure 3, the western portion of Florida Bay is occupied by wide mud banks (1.0-6.0 km in width), with small islands (57 islands > 100 m^2 which comprise < 1 % of the area of the western bay) (Enos 1989). The central portion of Florida Bay contains narrow mud banks (0.1-1.0 km in width) and abundant islands of varied size (150 islands > 100 m^2 which comprise ~3% of the area of the central bay) (Figure 3, Enos 1989). The northeastern portion of Florida Bay contains fewer mud banks and islands (30 large islands > 100 m^2 which comprise ~2% of the area of the northeastern bay) (Figure 4, Enos 1989). The islands are composed of marl and the vast majority are occupied by a mangrove fringe or forest, although green algae, salt-tolerant herbs (halophyte marshes), and occasional grasses and trees also occur (NPS 1979, Enos 1989). The islands provide important shelter, foraging, and nesting sites for a variety of animals (Enos 1989).

Sinuously-shaped mud banks are a common feature within the western and central portions of Florida Bay (Figures 3 and 4, Enos 1989, RECOVER 2010). The tops of these mud banks are typically flat (mud flats) with sides that slope down into shallow basins (also referred to as 'lakes') that are connected by natural and man-made water channels (Sogard et al. 1987, NPS SFNRC 2008). The mud banks, together with the bay's islands, act to create a patchwork of more than 40 basins, which are natural areas of slightly deeper water up to three meters in depth (Schomer and Drew 1982, Lee et al. 2008, Madden et al. 2009, RECOVER 2010). The physical separation provided by the banks reduces the effects of tidal variance on water levels and mixing within Florida Bay, creating distinct gradients in substrate composition, nutrient levels, salinity, and other environmental parameters (Hudson et al. 1970, Rudnick et al. 2005, NPS SFNRC 2012). These banks are comprised mainly of sediment of biotic origin, specifically carbonate skeletal debris mixed with small amounts of organic debris from mangroves and seagrasses (Bosence 1989). A majority of the mud banks and basins are occupied by seagrass beds, which act to stabilize the bank structures (NPS SFNRC 2012) and further restrict water exchange during periods of low water (Figure 2, Lee et al. 2006, 2008).

Hardbottom habitat is found most frequently in the southern portion of Florida Bay (Figure 2, Hunt and Nuttle 2007) and is defined as "exposed areas of rock or consolidated sediments, distinguished from surrounding unconsolidated sediments, which may or may not be characterized by a thin veneer of live or dead biota" (Street et al. 2005). Common inhabitants of the bay's hardbottom communities include octocorals, gorgonians, sponges, and macroalgae (Jaap 1984, Chiappone and Sullivan 1994). While Florida Bay is devoid of the extensive scleractinian coral reefs found in the adjacent Florida Keys, small colonies of *Porites* spp. are found scattered within seagrass beds and hardbottom areas of Florida Bay (Hudson et al. 1970).

1.1.3.2 Issues of Concern

Both ENP and Florida Bay draw visitors from around the globe, offering unique and spectacular wildlife, recreational opportunities, and solitude (NPCA 2005). Florida Bay is also a world-class recreational fishing destination (NPCA 2005). The complex landscape of mud banks, mud flats, basins, channels, and mangrove islands within Florida Bay creates a labyrinth for boater

navigation (NPS SFNRC 2008). This complicated landscape, coupled with the extremely shallow waters of the bay (averaging 1-1.5 m deep), creates an extremely challenging environment for safe boat operation (NPCA 2005, NPS SFNRC 2008). Thus, the bay's seagrass and mud habitats (shallows and banks) are susceptible to damage resulting from operation of motorized watercraft by inexperienced or careless operators (NPS SFNRC 2008). As discussed in Section 1.1.6.2, seagrass damage is typically in the form of propeller (prop) scars and blow holes. Repetitive vessel damage in heavily used locations can lead to disruption of the bathymetric contours and permanent loss of seagrass habitat.

1.1.4 Water Quality and Flow

ENP is part of a massive freshwater system called the Kissimmee-Lake Okeechobee-Everglades Watershed, which encompasses nearly 11,000 square miles in south-central Florida (NPS 1997, 2013a). Historically, freshwater sheet flow moved south through the Everglades system and emptied into Florida Bay or the Ten Thousand Islands (Figures 6 and 7, SFWMD 2000). Currently, Taylor Slough (Figure 6) provides the major freshwater flow in the eastern portion of ENP and empties into the northeastern portion of Florida Bay (NPS 2013b). Shark River Slough (Figure 6) is the largest slough in ENP and flows in a southwestern direction through ENP toward Whitewater Bay and the Gulf coast of Florida (Livingston 1990). Shark River Slough drains into the small stream and mangrove estuaries that feed the northwestern portions of Florida Bay (NPS 2013b).

The highly subdivided nature of Florida Bay and its shallow water depths reduce the effects of tidal flows and water mixing within the bay and leave the area highly subject to evaporation and freshwater influxes directly from Taylor Slough and indirectly from Shark River Slough via Whitewater Bay (Hall et al. 2007). Historically, Florida Bay was dominated by freshwater runoff during the wet season and became a hypersaline marine lagoon during the dry season. However, during the 20th century, two major anthropogenic changes altered the input and output flow patterns of Florida Bay (Swart et al. 1999, Rudnick et al. 2005). First, alteration of freshwater flow from the mainland began in the late 1800s and accelerated after 1920 with the construction of drainage canals, the Tamiami Trail, the Central and South Florida Flood Control Project, and the South Dade Conveyance System (Rudnick et al. 2005). Diversion of water from the Everglades via drainage canals, agricultural use, and other development has cut the freshwater influx to Florida Bay by as much as 60% over the past 100 years (Madden et al. 2009). A second major anthropogenic alteration was the construction of the Flagler Railway through the Florida Keys, which filled in several passes connecting Florida Bay to the Atlantic Ocean. This resulted in an immediate change of salinity regimes within Florida Bay, likely due to increased water residence times (Swart et al. 1999, Rudnick et al. 2005). Salinity levels in Florida Bay can reach 60 parts per thousand (ppt) during the peak dry season in late spring, particularly in the central portion of the bay where water circulation is most limited. Salinities over 70 ppt are not uncommon in central Florida Bay during extended drought periods (Hall et al. 2007). Large freshwater discharges that have occurred are likely to be "pulsed" due to flood-control measures, i.e. water releases, resulting in large, rapid variations in salinity that can potentially stress flora and fauna.

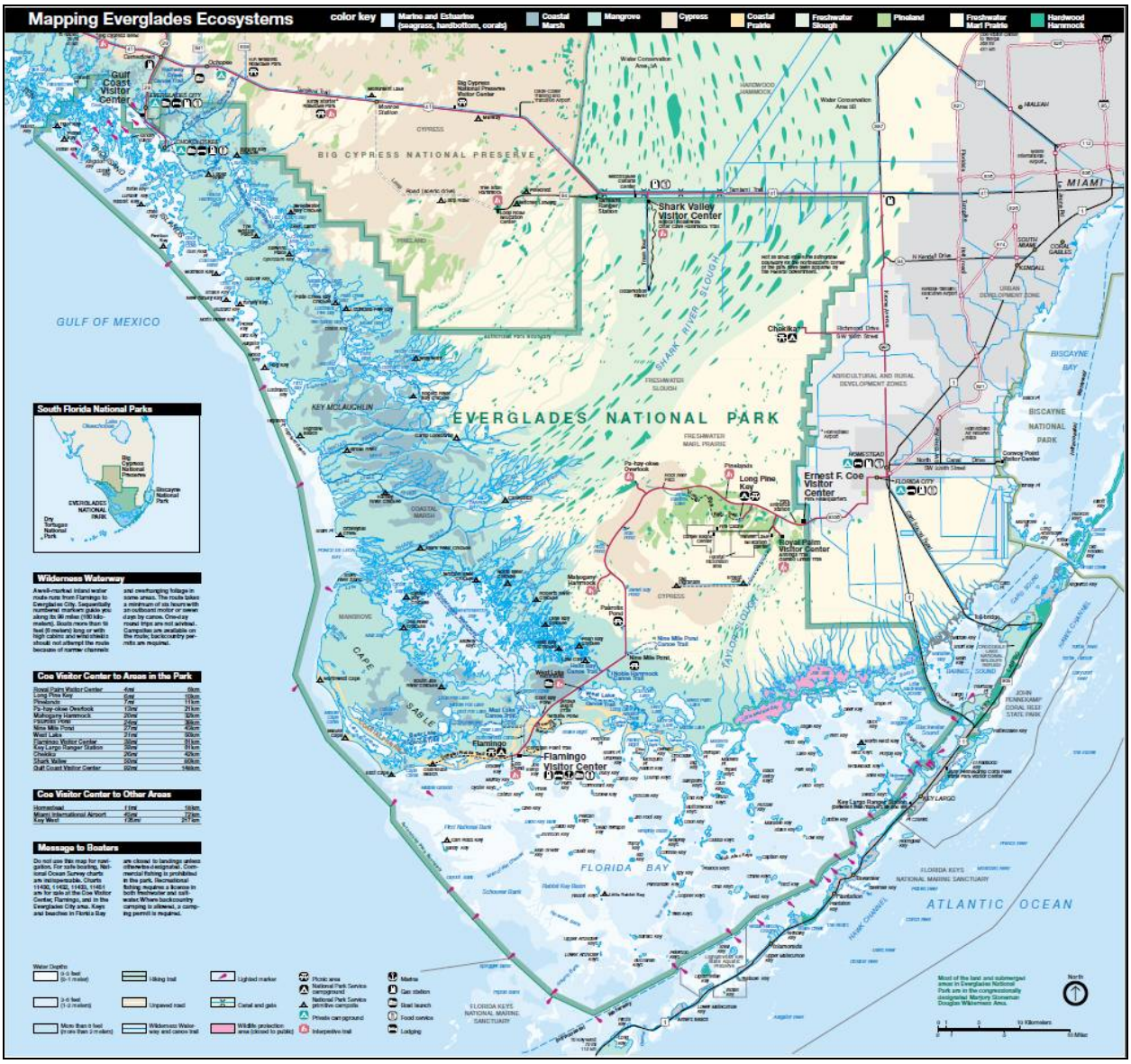

Figure 6. Map of Everglades National Park. Image from NPS 2013b.

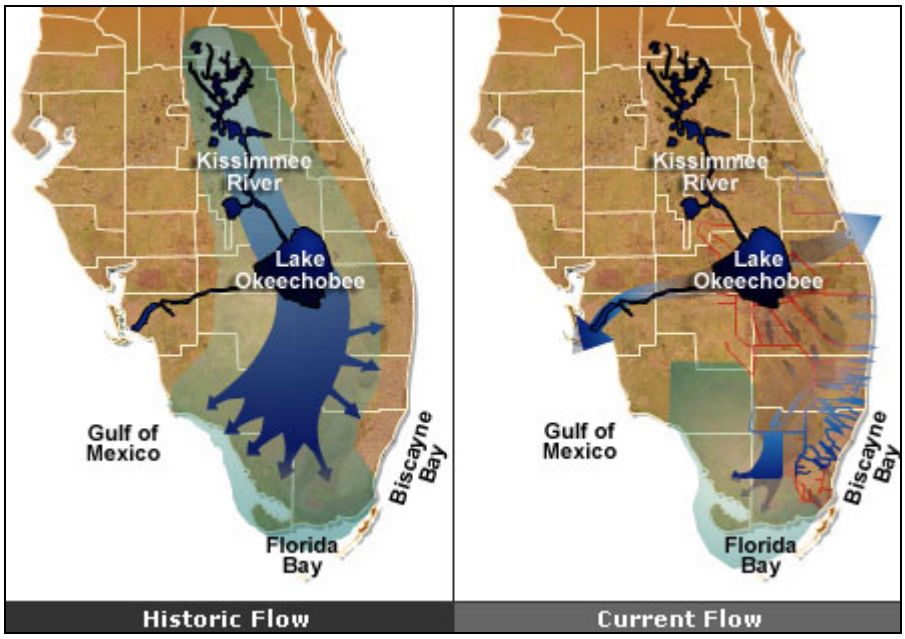

Figure 7. Historic and current water flows through ENP. Image from CERP 2013.

Historically, the fresh water feeding Florida Bay was oligotrophic (low nutrient levels) (NPS 2013a). However, urban development in south Florida has altered the nutrient levels of waters entering Florida Bay (NPS 2013a). The nitrogen and phosphorus derived from development and agricultural fertilizer use within the Everglades watershed are an ongoing concern due to their known capacity to disrupt aquatic ecosystems (Rudnick et al. 2005). There does not appear to be direct evidence of a widespread increase in nutrient input or concentration within the past century, despite the potential for anthropogenic nutrients from development, agriculture, and fertilizer manufacturing to enter the Everglades watershed (Madden et al. 2009). Fluctuations in nitrogen loading occur with freshwater inflows; however, it appears that the waters of the Florida Bay generally have little or no phosphorus present (Hunt and Nuttle 2007). It is believed that nutrients are likely retained within sediments and can be introduced to the water column when sediments are disturbed (Hunt and Nuttle 2007). Between 2005 and 2008, northeastern Florida Bay experienced stormwater discharges from multiple hurricanes (i.e., Katrina, Rita, and Wilma in 2005) as well as a highway widening project (i.e., US Highway 1 widening between Florida City and Key Largo) which involved cutting and mulching of mangrove vegetation. The combination of these events appears to have contributed to elevated phosphorus levels, a large and persistent algal bloom, and significant seagrass and benthic sponge mortality in the bay (Gilbert et al. 2009).

While each basin in Florida Bay can be considered to have its own unique water quality characteristics, the bay can generally be subdivided into zones based on salinity, nutrient composition, oceanic exchange, and bottom type. One zone is the mostly terrestrial "transition" zone of mangroves and estuarine lakes along the northeast shoreline of the bay (Madden et al. 2009, NPS SFNRC 2012). Some sources have simplified the Florida Bay zonation into three zones (i.e., western, central, and northeastern), primarily on the basis of salinity and

phytoplankton composition (Hunt and Nuttle 2007). The western zone has the greatest exchange with the Gulf of Mexico and thus the lowest variation in salinity, along with a nitrogen-limited nutrient base and common diatom-dominated phytoplankton blooms in late summer. The central zone has little freshwater runoff or oceanic exchange and is typically characterized by high salinity, high ammonium concentrations, and cyanobacterial-dominated algal blooms in summer and early fall. The northeast zone is the most removed from oceanic exchange and it receives the greatest freshwater inputs, resulting in large seasonal variations in salinity, a phosphorus-limited nutrient base, and until 2005-2007, was typically free of large-scale phytoplankton blooms (Hunt and Nuttle 2007, Gilbert et al. 2009).

1.1.4.1 Issues of Concern

Salinity, a key stressor in the Florida Bay ecosystem, is recognized as the most critical environmental factor affecting seagrass health (Madden et al. 2009) and the unnatural, erratic freshwater flows into Florida Bay affects the bay's salinity levels (Section 1.1.4). Hypersaline (high salinity) conditions are believed to favor monotypic, stenohaline (only able to survive within a narrow salinity range) seagrass assemblages that may exhaust sediment nutrients and be more vulnerable to sudden community collapses, such as the 1987 seagrass die-off in Florida Bay (Rudnick et al. 2005, Madden et al. 2009). In addition to physiological stress on seagrass, high (≥35 ppt) salinity levels may promote infection by *Labyrinthula* slime mold (Durako and Kuss 1994). Nutrients (nitrogen and phosphorus) introduced to Florida Bay can be sequestered in the carbonate-rich sediment, which can ultimately compound the impacts that occur when seagrass beds are damaged. Sediments suspended as a result of vessel-related damage may release nutrients and trigger algal blooms over the damaged area (Rudnick et al. 2005). This can result in increased turbidity, continuing seagrass losses, and further suspension of sediment and nutrients. The sustained algal bloom seen in northeastern Florida Bay between 2005 and 2007 was likely associated with stormwater releases (high nutrient content and low salinity), as well as clearing and mulching of shoreline vegetation during the highway widening project (Gilbert et al. 2009). Gilbert et al. (2009) stated that the "unprecedented algal blooms in Florida Bay are evidence that this unique subtropical ecosystem responds to natural and anthropogenic stressors in complex ways that impact most or all biotic components of the entire ecosystem." The Comprehensive Everglades Restoration Plan (CERP), described in Section 1.2.2.1, includes an effort to investigate the history of the Florida Bay, as well as a goal of determining efforts to restore water quality, quantity, timing, and distribution within the bay (Hunt and Nuttle 2007).

1.1.4.2 Desired Conditions

The March 2013 Draft GMP (see Section 1.2.1), identified the following desired conditions with regard to water quality in ENP and Florida Bay:

> *"Hydrologic conditions within ENP and the south Florida ecosystem are characteristic of the natural ecosystem prior to European American intervention, including water quality, quantity, distribution, and timing. Water levels and timing of water deliveries reflect quantities resulting from natural rainfall and are distributed according to pre-engineered drainage patterns. Water is free of introduced agricultural nutrients and urban-related pollutants."*

The Preferred Alternative identified in the March 2013 Draft GMP includes the establishment of pole and troll zones (PTZ) and a mandatory boater education and permitting program. These measures will potentially benefit water quality (on a long-term, localized, minor-to-moderate scale) by reducing the number of boat groundings and bottom disturbances, thereby reducing turbidity (NPS 2013a).

1.1.5 Biological Resources

ENP is the only subtropical preserve in North America and contains a truly unique gradient of habitat types and ecotones, resulting in a diverse mix of biological resources and an ecological transition zone between temperate and tropical species (Sogard et al. 1987, NPS General Management Plan Newsletter One). Overall, the marine environment of south Florida is considered to be a mixing zone between West Atlantic, Gulf of Mexico, and Caribbean forms (Sogard et al. 1987). As discussed in Section 1.1.4, the varying salinities encountered within Florida Bay between different zones and seasons can lead to a mixing of estuarine and marine species (Ley et al. 1994).

1.1.5.1 Seagrass

The majority of Florida Bay's benthic habitat is covered by seagrasses, as discussed in detail within Section 1.1.6 of this document, with limited expanses of bare soft-substrate and hardbottom (Figure 2, Chiappone and Sullivan 1994). Biological sampling conducted in a seagrass basin in central Florida Bay (i.e., Porpoise Lake) between April 1965 and January 1968 revealed habitat that supports a large variety of marine algae, mollusks, crustaceans, echinoderms, and fish (Hudson et al. 1970). Biological communities in seagrass beds can be subdivided into an epibenthic component living in and among the vegetation and a pelagic component utilizing the water column above the grass beds (Sogard et al. 1987). Hunt and Nuttle (2007) describe the epibenthic and pelagic seagrass biological communities. Epibenthic organisms include filter feeders (e.g., sponges, bivalve mollusks, ascidians, polychaetes), demersal (bottom-dwelling) grazers and detritivores (e.g., amphipods, copepods, polychaetes, mullet), and demersal fish that forage on invertebrates (e.g., killifish, pipefish, mojarra, grunt, pigfish). The juvenile spiny lobster (*Panulirus argus*) is abundant in southwestern Florida Bay. Pelagic organisms include planktonic organisms (e.g. larval fishes, crustaceans, and mollusks), along with the schooling pelagic fish that feed on them (e.g., anchovies, silversides), piscivorous fish species, sharks, and rays.

1.1.5.2 Fisheries

Many of south Florida's coastal fisheries have an ecological connection to Florida Bay, as they spend a portion, or portions, of their life cycles in the bay's seagrass, mud, and hardbottom habitats (Hunt and Nuttle 2007). These species include sparids, grunts, snappers, and groupers (Hunt and Nuttle 2007). Key species in Florida Bay's food web are the bay anchovy (*Anchoa mitchilli*) and Spanish sardine (*Sardinella aurita*), which are prey species for piscivorous predators (NPS 2013a). Important recreational game fish species, including bonefish (*Albula vulpes*), spotted seatrout (*Cynoscion nebulosus*), gray snapper (*Lutjanus griseus*), snook (*Centropomus unidecimalis*), redfish (*Sciaenops ocellatus*), and tarpon (*Megalops atlanticus*), utilize Florida Bay as both nursery and adult habitat (Zieman and Zieman 1989, NPS SFNRC 2008). Spotted seatrout are of special importance as they reside in Florida Bay for their entire

life cycle and their larval forms are sensitive to hypersaline conditions, making them an indicator species for the central bay area (Rudnick et al. 2005).

Additionally, Florida Bay provides nursery habitat for the pink shrimp (*Farfantepenaeus duorarum*) and stone crab (*Menippe mercenaria*) commercial fisheries and the commercial and recreational fisheries for spiny lobster (Thayer and Chester 1989, Hunt and Nuttle 2007). While commercial fishing has been prohibited within ENP since 1985, these nursery areas serve as a population source for the Florida Keys and Tortugas Bank (Hudson et al. 1970, Madden et al. 2009). Florida Bay also provides habitat and feeding grounds for several state- and federally-protected species (Section 1.1.7) and seagrass within Florida Bay is designated as Essential Fish Habitat (EFH) for several managed fishery species (Section 1.1.8).

1.1.5.3 Mangroves

Florida Bay's shorelines and islands constitute the largest mangrove ecosystem in the Western hemisphere (Figures 2-4, NPS General Management Plan Newsletter One), which is dominated by red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood (*Conocarpus erectus*) (Davis et al. 2005, NPCA 2005). Mangroves are closely linked with the health and functionality of Florida Bay's ecosystems and serve as an interface between the freshwater Everglades drainage basin and estuarine and marine waters of Florida Bay. The mangrove trees and forests provide refuge for juvenile marine fish and invertebrates as well as stable perching and nesting areas for birds. Leaf detritus from mangrove forests is an important source of organic matter and nutrients for marine habitats (Davis et al. 2005).

1.1.5.4 Birds

Florida Bay provides important refuge, foraging habitat, and/or nesting/rookery habitat for a variety of North American wading birds and shorebirds, including the double-crested cormorant (*Phalacrocorax auritus*), limpkin (*Aramus guarauna*), brown pelican (*Pelecanus occidentalis*), roseate spoonbill (*Platalea ajaja*), great white heron (*Ardea herodias occidentalis*), reddish egret (*Egretta rufescens*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), white ibis (*Eudocimus albus*), and glossy ibis (*Plegadis falcinellus*) (NPS 1979).

1.1.5.5 Issues of Concern

Section 4.4 of the *NPS Management Policies 2006* states that the NPS is required to maintain native plants and animals within park ecosystems by (1) preserving and restoring natural populations and their associated communities and ecosystems, (2) restoring park populations that have been removed or decimated by human action, or (3) acting to minimize human impacts to resources, communities, and ecosystems. Florida Bay's value is largely derived from the ecologically and commercially important animal species that depend on the ecosystem (Hunt and Nuttle 2007).

Widespread seagrass losses beginning in 1987 resulted in large-scale phytoplankton blooms in central and western Florida Bay over the next several years (Madden et al. 2009). Loss of seagrass habitat had an extensive impact on higher trophic levels, including declines in pink

shrimp and spiny lobster at the Tortugas Banks and gamefish landings within ENP (Robblee et al. 1991, Butler et al. 1995, Fourqurean and Robblee 1999). Sponge populations within Florida Bay were also impacted, with some species exhibiting 100% mortality (Fourqurean and Robblee 1999, Peterson et al. 2006). The impact on sponge populations likely worsened local water quality. Prior to the 1987 die-off, it was estimated that the sponge population within Florida Bay could filter the bay's entire water volume over a 24-hour period (Hunt and Nuttle 2007). At present densities, it is estimated to take four days for the sponge population to accomplish the same capacity (Hunt and Nuttle 2007).

In cases of small-scale losses of seagrass habitat (e.g., propeller scarring), direct impacts to higher trophic levels appear to be limited (NPS SFNRC 2008). However, extensive seagrass damage has been correlated with a reduction in growth rates for pinfish and white shrimp, and extensive fragmentation (loss of > 50% coverage) of seagrass beds can lead to a rapid loss of structural complexity of bottom habitat (Fonseca and Bell 1998, Bell et al. 2001).

1.1.5.6 Desired Conditions

The ecosystem in Florida Bay is highly reliant on seagrass health, and thus ENP management goals for Florida Bay's marine and avian wildlife must include maintenance of seagrass beds. The desired conditions for natural resources/biological diversity, wildlife, and fisheries identified in the March 2013 Draft GMP are as follows:

> *"The resources and processes of the national park retain a significant degree of ecological integrity. Management decisions about natural resources are based on scholarly and scientific information and on the national park's significant resources. Park resources and values are protected through collaborative efforts with neighbors and partners. Visitors and employees recognize and understand the value of the park's natural resources. Human impacts on resources are monitored, and harmful effects are minimized, mitigated, or eliminated. Biologically diverse native communities are protected and restored when possible. Particularly sensitive communities are closely monitored and protected…"*
>
> *"Natural wildlife populations and systems are understood and perpetuated. Natural fluctuations in populations are permitted to occur to the greatest extent possible. Natural influences are mimicked if necessary. NPS staff work with neighbors and partners to achieve mutually beneficial goals related to wildlife."*
>
> *"Native fish populations and habitat are understood and perpetuated. Naturally functioning and healthy fisheries are maintained as an important component of the ecology of Florida Bay and other waters in the park."*

Strategies for meeting these desired conditions would include continued cooperation with the Florida Fish and Wildlife Conservation Commission (FFWCC), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) on population status and management actions, preservation of populations and habitats, and education of visitors and the public (NPS 2013a). The seagrass restoration protocols outlined in this plan (identified as the "formal

seagrass restoration plan" in the Preferred Alternative of the March 2013 Draft GMP) are expected to result in "long-term, minor, localized, benefits" to seagrass habitat and associated wildlife (NPS 2013a). In addition, the implementation of other Preferred Alternative measures including PTZs, idle speed/no wake zones, a mandatory boater education permit program, a boating safety and resource protection plan, and increased law enforcement will also benefit wildlife associated with seagrass habitats. The PTZs and idle/speed zones will reduce noise and boat wake disturbances to nesting, roosting, and foraging birds within and along mangroves and shorelines (NPS 2013a). The boater education permit program and increased law enforcement will raise boater awareness and compliance, which will reduce impacts to seagrass habitat and other wildlife resources. The boating safety and resource protection plan will increase boater knowledge and therefore reduce habitat disturbance (via noise or grounding incidents) (NPS 2013a).

1.1.6 Seagrass

1.1.6.1 General Description and Factors Affecting Seagrass in Florida Bay

Submerged aquatic vegetation (SAV), composed of seagrass and macroalgae, occupy shallow coastal waters worldwide; however, few areas are as extensive as the seagrass beds found in south Florida (RECOVER 2010, Durako et al. 2007, Fourqurean et al. 2002). Seagrasses are considered a keystone community of the Florida Bay ecosystem, historically covering over 90% of the ~1,800 km^2 of subtidal mud banks and basins (Durako et al. 2007, Zieman et al. 1989, 1999). Seagrass communities are integral to the ecological function of Florida Bay and provide food sources, habitat, organic carbon production, nutrient cycling, and sediment stabilization, and act as a large nutrient sink, restricting nutrient availability to phytoplankton, thereby lessening potential algal blooms (RECOVER 2010, Orth et al. 2006, Rudnick et al. 2005). Seagrasses are also important economically as they provide food and shelter to numerous recreational and commercial fish and invertebrate species (Powell et al. 1989a, Thayer and Chester 1989, Tilmant 1989, Chester and Thayer 1990). Furthermore, seagrass communities comprise the cornerstone of the natural quality of wilderness character within Florida Bay, providing biological, economical, and wilderness values.

Since 1995, the south Florida Fisheries Habitat Assessment Program (FHAP) has provided data on the spatial distribution, abundance, and species composition of SAV in Florida Bay (RECOVER 2010). Results revealed that turtle grass (*Thalassia testudinum*) is the dominant seagrass species in Florida Bay, occupying ~1,900 square miles (RECOVER 2010, NPS 2013a). However, *T. testudinum* is considered a "climax species" and colonizes areas less rapidly than the other two common species, manatee grass (*Syringodium filiforme*) and shoal grass (*Halodule wrightii*) (NOAA and FDEP 2004). *H. wrightii* is also consistently present in Florida Bay, although in lower densities than *T. testudinum*. It is an early colonizer and can be found in areas where sediment has been disturbed (NPS 2013a). *S. filiforme* generally occurs in the deeper waters in western Florida Bay near the Gulf of Mexico (Madden et al. 2009). Additionally, widgeon grass (*Ruppia maritima*) is observed along the northern border of Florida Bay, within the mangrove transition zone (Madden et al. 2009).

Several factors affect seagrass growth and distribution, including temperature, salinity, light, turbidity, epiphytes, nutrients, sulfide, *Labyrinthula* infection, and sediment characteristics (Durako et al. 2007). Salinity is identified as the most important controllable factor or stressor influencing seagrass growth and distribution in Florida Bay (Fourqurean and Robblee 1999). In the fall of 1987, the Florida Bay seagrass community experienced an abrupt widespread mortality event (Robblee et al. 1991) that destroyed ~40 km^2 or ~5% of the *Thalassia testudinum* community and also adversely impacted an additional 230 km^2 (Robblee et al. 1991), resulting in a total impact to ~30% of the entire seagrass community (Madden et al. 2009, Hall et al. 1999, Durako et al. 2002). Salinities recorded during this initial die-off episode ranged from 45 to 70 ppt (Durako et al. 2007). It has been hypothesized that the mass seagrass die-off in the 1980s was a direct result of the long-term increase in salinity associated with diversion of freshwater flow from Florida Bay via the drainage canal system in south Florida (Rudnick et al. 2005). However, additional research has shown that increased salinity was only part of the problem and other factors, both anthropogenic and natural, likely played a role including:

- An altered salinity regime as a result of decreased freshwater flow from the Everglades, reduced exchange with marine waters of the Gulf of Mexico and Atlantic Ocean, sea-level rise, and frequency of major hurricanes (Rudnick et al. 2005, Smith et al. 1989, Swart et al. 1996, 1999);

- Increased nutrient (nitrogen and phosphorus) inputs from expanding agriculture and residential development in south Florida and the Florida Keys and the construction of the South Florida Water Management District (SFWMD) canal system which transports materials through wetlands toward Florida Bay, decreasing nutrient retention in the wetlands and increasing inputs to Florida Bay. Increased nutrients can result in increased algal blooms, increased incidences of hypoxic and anoxic events, and loss of seagrass (Rudnick et al. 2005);

- Increased application of pesticides and other toxic materials with widespread agricultural and residential development in south Florida and subsequent release of these toxic materials through water management, affecting their distribution and potentially their transport into Florida Bay (Rudnick et al. 2005, Scott et al. 2002, Rumbold et al. 2003);

- Increased fishing pressure that directly affect population dynamics and community structure of Florida Bay. Commercial fishing has been prohibited in ENP since 1985; however, populations that spend part of their life cycle outside of park boundaries are affected by fishing activity (Rudnick et al. 2005, Tilmant 1989);

- High summertime temperatures and high sediment sulfide levels have reduced seagrass productivity (Durako et al. 2007, Rudnick et al. 2005, Zieman et al. 1999, Koch et al. 2007) and depleted oxygen concentrations in the seagrass root zone and meristems (Borum et al. 2005); and

- Seagrass wasting disease, caused by the slime mold, *Labyrinthula* sp., is common at salinities near (or greater than) seawater. High salinities may have played a role in the

initial seagrass mass mortality in the 1980s but more likely has served to promote seagrass re-infection by *Labyrinthula* sp. since that event (Durako et al. 2007).

Regardless of the cause of the mass mortality event in the 1980s, the ecology of Florida Bay has been altered (Rudnick et al. 2005). Continued seagrass mortality in the 1990s resulted in increased sediment resuspension (Prager and Halley 1999, Stumpf et al. 1999), which resulted in increased nutrient release from sediments, stimulating phytoplankton growth (Rudnick et al. 2005). This resulted in additional seagrass loss due to decreased light availability and reduced photosynthesis. Results of the south Florida FHAP have revealed significant seagrass trends when analyzing long-term data (1995 to 2008) (RECOVER 2010). In 1995, seagrass cover was sparse and water clarity was poor in western Florida Bay. Over time, water quality improved and seagrass frequency and density increased. *Halodule wrightii*, the fastest growing species, showed the most rapid response but *Thalassia testudinum* and *Syringodium filiforme* also increased. *H. wrightii* peaked in 2000 and has since declined, while *T. testudinum* and *S. filiforme* have continued to increase. These changes in species abundance are following a secondary successional pattern and have resulted in a mixed seagrass community dominated by *T. testudinum* (RECOVER 2010).

1.1.6.2 Issues of Concern

As part of ENP, Florida Bay falls within the designated MSD Wilderness. Florida Bay's SAV and bottom habitat are defined as federally designated submerged marine wilderness and are protected by law as a significant wilderness resource (ENP Wilderness Act of 1978). In addition, seagrass within Florida Bay is designated as EFH for several managed fishery species (Section 1.1.8). Growing human populations, increased fishing pressure, habitat alterations, and watershed management (i.e., overall lack of freshwater delivery) have placed significant stress on the marine environment over time (Ault et al. 2008, 1998, 2005). While the primary environmental stressors in Florida Bay are related to watershed management (as discussed in Section 1.1.6.1), recreational boat use has also contributed to benthic resource damage (NPS SFNRC 2008). Florida Bay represents one of the leading shallow-water boating and fishing destinations in the world. As a result, boating has become increasingly popular. An aerial census of ENP boat use in 2006-2007 revealed that boater use had increased 2.5 times between the 1970s and the time of the survey (Ault et al. 2008). Any damage to Florida Bay's SAV communities from the operation of motorized watercraft compromises the wilderness character and value of the submerged marine wilderness.

Boats equipped with propellers have been shown to cause direct damage to seagrasses. As the boat propeller comes into contact with the seagrass and associated sediment, a propeller scar (hereafter referred to as "prop scar") forms within the seagrass bed (Figure 8). When vessels run aground, large holes or "blow holes" are created when boaters attempt to dislodge their vessel by using the motor's power (Figure 9). Both prop scars and blow holes create structural changes in the seagrass community from physical destruction and disruption of the seagrasses, sediment resuspension (potentially increasing turbidity and occurrence of algal blooms which affects surrounding healthy seagrass), burial of adjacent seagrasses due to sediment excavation, and an increased susceptibility to storm damage (NPS SFNRC 2008, Duarte et al. 1997, Whitfield et al. 2002). Natural recovery time for prop scars varies depending upon the seagrass species affected,

sediment type and source, and the severity of damage; however, estimates range from less than one year to more than seven years (NPS SFNRC 2008). Results of experiments conducted in Florida Bay revealed that *Halodule wrightii* and *Syringodium filiforme* recover five to seven times faster than *Thalassia testudinum* (NPS 2013a), which is the dominant seagrass species in the bay. Deep prop scars (i.e., 10-20 cm scour depth) can disrupt the seagrass rhizome (root) structure and biomass, making natural seagrass recovery more difficult and making the scar more susceptible to continued erosion/expansion (NPS SFNRC 2008).

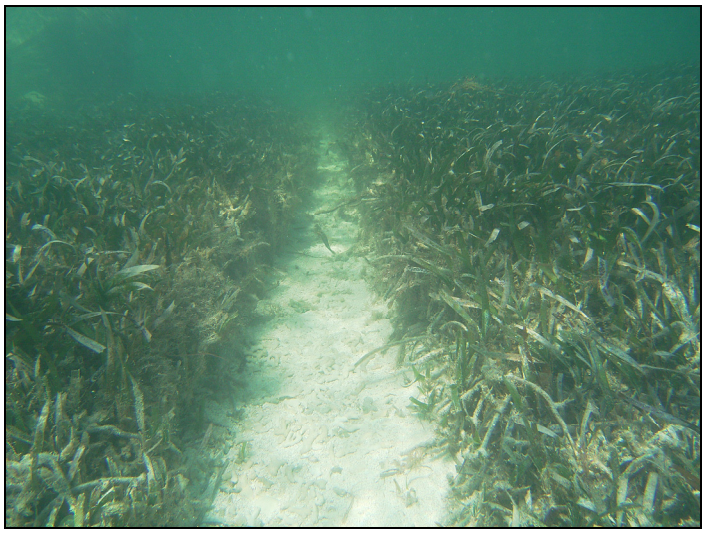

Figure 8. Photograph of a prop scar collected at Red Bay Banks in the Florida Keys National Marine Sanctuary (photo credit: Atkins).

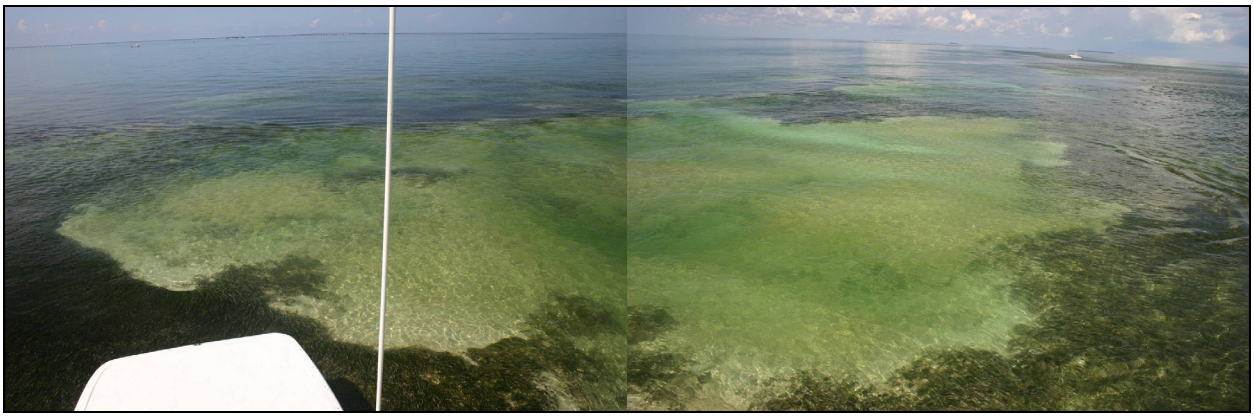

Figure 9. Photograph of a blow hole created during the *Myra Lee* vessel grounding in the Florida Keys National Marine Sanctuary (photo credit: Atkins).

Since 1995, several prop scarring studies have been conducted within Florida Bay. These studies utilized different approaches and methodologies to quantify prop scarring. Sargent et al. (1995) identified and quantified seagrass scarring within Florida's shallow coastal waters. Thirty-one of Florida's 35 coastal counties were included in the survey. Polygons were drawn around groups

of prop scars and each polygon was classified according to scarring intensity. Approximately 30,050 ac (~120 km^2) of scarred seagrasses were reported within Monroe County (including Florida Bay and the Florida Keys). Based on county-wide rankings, Monroe County had the most seagrass and the most moderate and severe scarring in comparison to all other counties within the study area (Atkins 2011, Sargent et al. 1995).

A second prop scarring study was completed by the NPS South Florida Natural Resource Center (SFNRC) in 2008 to quantify seagrass scarring within Florida Bay (NPS SFNRC 2008). Georeferenced digital imagery (collected in 2004) was used to digitize individual prop scars to determine scarring densities. Approximately 12,000 line segments representing ~325 mi of prop scars were recorded (Figure 10, NPS SFNRC 2008). Additional analysis of higher resolution imagery captured at Garfield, Rankin, and Snake Bights in 2006 revealed that total scarring distance in 2004 was likely underestimated by a factor of 10 (Figure 10, NPS SFNRC 2008). Regression analyses were performed on the 2004 data to examine relationships between scar density and a variety of variables, including water depth, channels, marine facilities, boat use, and shorelines. Prop scarring patterns revealed high prop scar densities in shallow water depths, near navigation channels, and around areas most heavily used by boats. This study concluded that scarring was not improving over time within Florida Bay and that new management strategies were needed in order to protect the seagrass habitat (Atkins 2011, NPS SFNRC 2008).

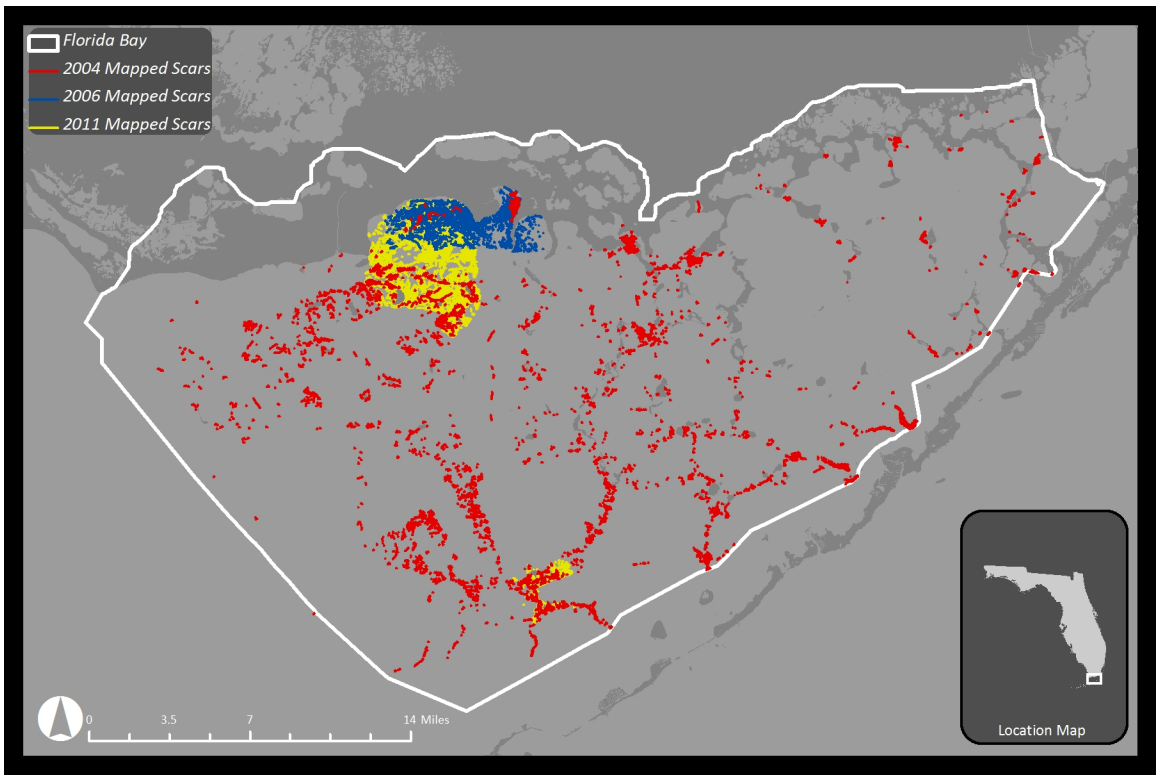

Figure 10. Results of prop scarring studies conducted in Florida Bay in 2004, 2006, and 2011 (NPS SFNRC 2008, Atkins 2011). Prop scars were digitized throughout Florida Bay in 2004, in Garfield, Rankin, and Snake Bights in 2006, and in the Snake Bight PTZ and Treatment Areas 1 and 2 in 2011.

1.1.6.3 Management and Protection Measures

Several management and protective measures have been implemented in Florida Bay to address the increasing problem of seagrass damage associated with shallow water boating. These measures include: resource management (e.g., PTZs and closed areas), law enforcement, education, and improved signage.

On January 1, 2011, ENP implemented a PTZ in Snake Bight as a management strategy to help "protect sensitive aquatic vegetation and wilderness resources, improve the quality of flats fishing, enhance paddling and wildlife viewing opportunities, and expand education on proper shallow-water boating techniques" (NPS 2011, Atkins 2011). Within a PTZ, boaters are required to shut off their internal combustion motors and switch to drifting, poling, paddling, and/or the use of electronic trolling motors (USFWS 2009, Atkins 2011). In order to determine the effectiveness of a PTZ as a management strategy within ENP, a study was initiated in 2011 to quantify the amount of prop scarring within the Snake Bight PTZ and compare it to Treatment Areas 1 and 2, areas that do not have restrictions to combustion engine use (Figures 10 and 11, Atkins 2011). The data collected in 2011 represent the state of prop scarring immediately prior to implementation of the PTZ within Snake Bight and will be compared to future monitoring events in order to determine the effectiveness of a PTZ as a management strategy within ENP (Figure 11).

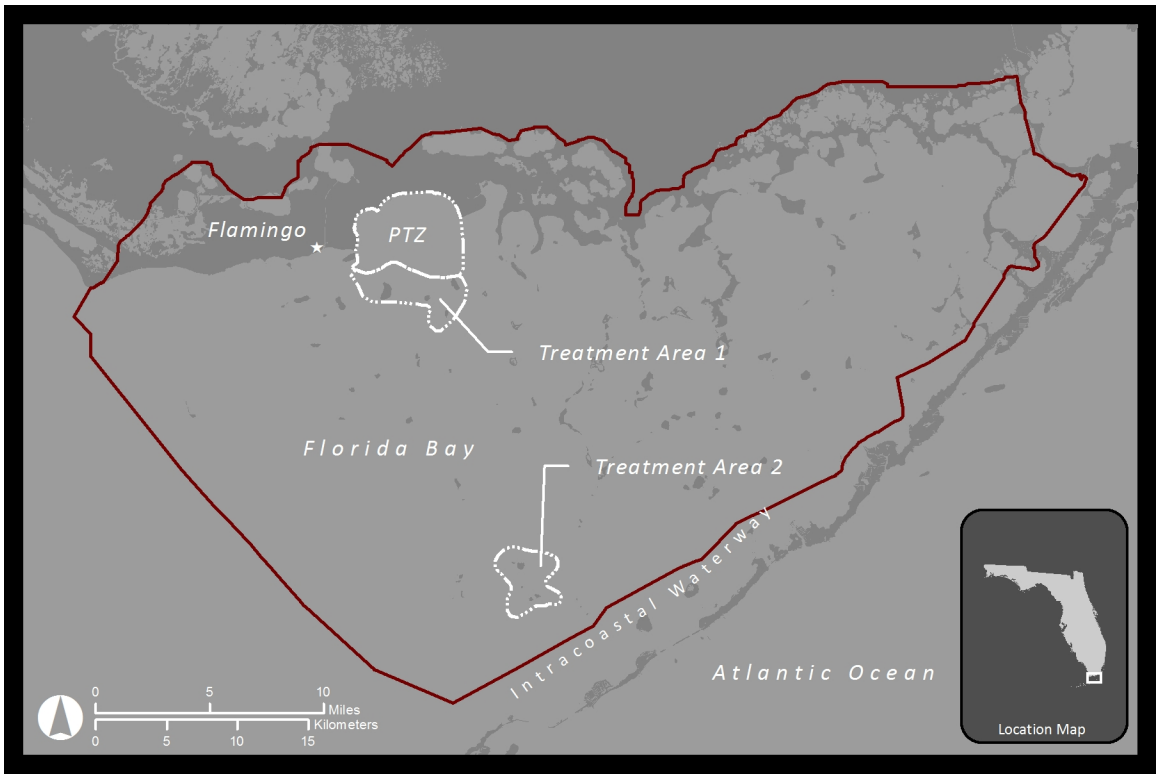

Figure 11. Overview map showing the boundaries of Florida Bay and the three project areas: the Snake Bight PTZ, Treatment Area 1, and Treatment Area 2 (Atkins 2011).

The March 2013 Draft GMP identified a Preferred Alternative that proposes the designation of ~131,392 acres (~532 km^2), or ~33%, of Florida Bay as PTZs to protect the bay bottom, wilderness resources, SAV, and important ecological habitats. The PTZs would be accessible to boaters via designated channels and routes (NPS 2013a).

In addition to the PTZ, several areas within Florida Bay are designated as "closed areas" by ENP. The ENP Superintendent Dan Kimball has issued the Everglades Compendium of Designations, Closures, Requests, Requirements and Other Restrictions (36 CFR, Chapter 1); hereafter referred to as the Everglades Compendium (most recent version dated December 14, 2012). The Everglades Compendium documents visiting hours, public use limits/restrictions, and closures for ENP. All public entry is prohibited at the following areas within Florida Bay to offer additional protection to wildlife habitat:

- Little Madeira Bay, Joe Bay, and adjacent smaller water bodies (also known as the Crocodile Sanctuary) – All public entry prohibited as these areas are managed as the special protection zone (Figure 12).

- The waters immediately adjacent to Porjoe, Sandy, Duck, and the Tern Keys (as posted) and the moats and internal creeks associated with the Buchanan Keys (as posted) – All public entry prohibited on these keys as well as a buffer zone of water in and around the keys to protect rookeries (i.e., habitat that is critical to nesting and rearing of young bird populations).

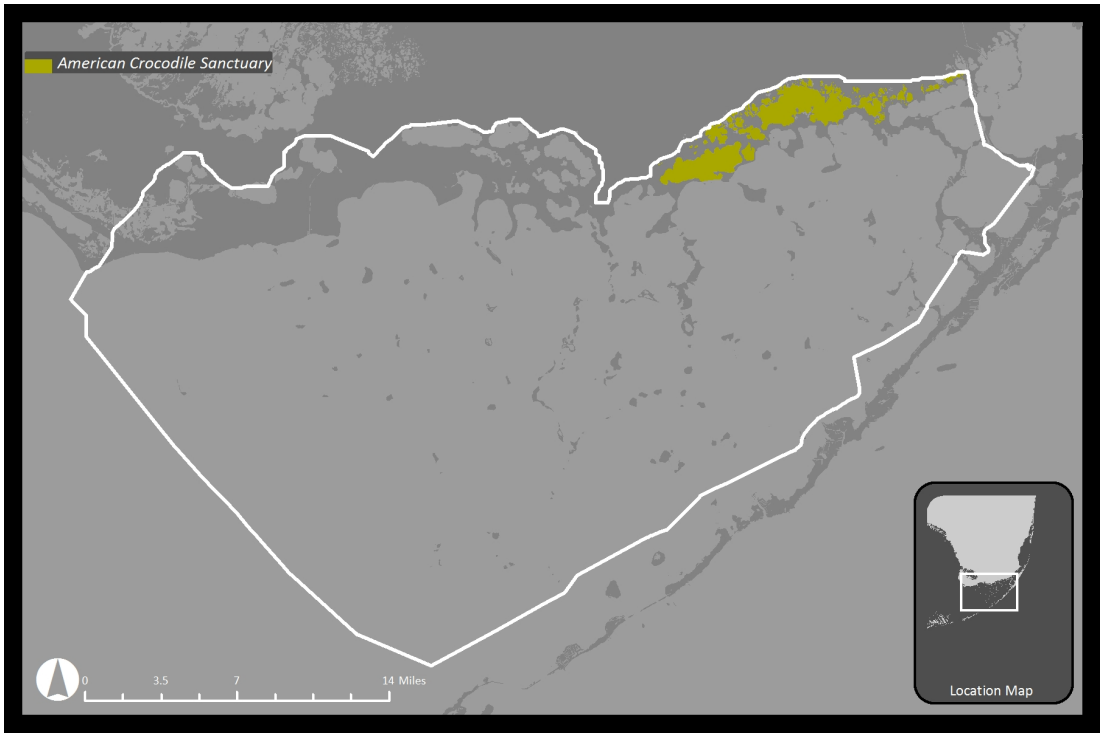

Figure 12. Designated American crocodile sanctuary located within Florida Bay. Data provided by ENP.

The Preferred Alternative identified in the March 2013 Draft GMP, proposes continued closure of Little Madeira Bay, Joe Bay, and the adjacent smaller water bodies. These areas would be closed to the public and managed as special protection zones to support long-term scientific/research efforts related to ecosystem restoration and ecological conditions.

Law enforcement is another measure utilized to protect submerged aquatic resources within Florida Bay. In carrying out the law enforcement program, NPS officers "make reasonable efforts to protect natural and cultural resources entrusted to its care and to provide for the protection, safety, and security of park visitors, employees, concessioners, and public and private property" (NPS 2006). The objectives of the NPS law enforcement program include "prevention of criminal activities through resource education, public safety efforts, and deterrence and the detection and investigation of criminal activity and the apprehension and successful prosecution of criminal violators" (NPS 2006). This includes investigation of boat grounding incidents in Florida Bay and potential prosecution of the violators under the Park System Resource Protection Act (PSRPA) (NPS 2004, Section 9.12). The process of investigation and prosecution provides a deterrent, heightening the public's awareness to the serious nature of vessel groundings and prop scarring in Florida Bay.

Education is one of the key management policies within ENP and Florida Bay. According to the NPS Management Policies (NPS 2006), the NPS operates educational programs designed to (1) perpetuate public awareness and appreciation for wilderness character and resources, (2) promote an understanding that the concept of wilderness includes respect for the resource, and (3) and encourage the public to use and accept wilderness on its own terms. Education pertaining to Florida Bay and its natural resources, including seagrasses, is achieved through visitor activities, interpretive media (e.g., ENP website, informative brochures and boat-user guides/maps available at marinas, signs at boat launching ramps, and educational videos and brochures regarding shallow water boating), scholarly research, and public input via workshops, seminars, and outreach meetings. Action alternatives described in the March 2013 Draft GMP include a boater education permit program that would require boat operators to complete a mandatory education program to obtain a permit to operate vessels in ENP (NPS 2013a). Program information would be tailored to the type of watercraft and would be widely available. Despite these efforts, implementation of a comprehensive and wide-ranging education program has been a challenge in Florida Bay due to the large number of access points, the diverse group of users, and the fact that education cannot substitute for on-the-water experience and local knowledge (NPS SFNRC 2008).

Improved signage is a management strategy and an administrative necessity used to protect the natural resources of Florida Bay. Aids to navigation (e.g., channel markers) and signage delineating the locations of PTZs, closed/limited access areas, and idle/speed zones are currently located within Florida Bay. The current channel marking system in Florida Bay consists of wooden stakes with directional arrows. These markers are located along popular boating routes. Improvements to these aids to navigation would include (1) maintenance of existing channel markers, (2) placement of new markers away from the edges of shallow seagrass beds (as possible) to create buffers and prevent unintentional prop scarring, and (3) installation of new markers in a gated (paired) orientation to clearly define channel boundaries and provide a clear

passageway for boaters (Sargent et al. 1995). Improvements to signage marking locations of PTZs, closed/limited access areas, and idle/speed zones include maintenance of existing markers and placement of new markers in locations that are readily understood and visible to boaters. In order to better address prevention of grounding incidents, ENP has partnered with other agencies and organizations such as the U.S. Coast Guard (USCG) for channel marking services and commercial towing operators for removal of grounded vessels (BNP 1996).

It is important to note the ever-increasing effectiveness of electronic devices (e.g., GPS, smart phone applications) for safe vessel navigation. It is highly likely that the use of these devices by boat operators will increase over time, potentially decreasing boater reliance on signage for safe vessel navigation.

1.1.6.4 Desired Conditions

According to the March 2013 Draft GMP, the desired condition for vegetation in ENP is to "…allow natural processes that enhance and maintain native plant communities" (including seagrasses). When seagrasses are damaged, the preferred restoration option is the natural, un-aided recovery of the damaged site (Section 4.4.4). However, in cases where natural restoration processes are not sufficient or would require an extensive timeframe, other management strategies used to obtain the desired condition include active restoration of disturbed sites, development of monitoring programs to detect the effects of man on native communities, and monitoring of communities to assess their condition. If it is demonstrated that human use is degrading an area, a variety of mitigating measures to restore the area to an acceptable condition should be considered (NPS 2013a). The Preferred Alternative identified in the March 2013 Draft GMP includes a formal seagrass restoration program, mandatory boater education and permitting program, and establishment of PTZs and idle speed/no wake zones (NPS 2013a). These new programs and changes in motorboat access will create long-term, bay-wide, moderate-to-major beneficial impacts to seagrass habitats in Florida Bay (NPS 2013a).

Within Florida Bay, the primary stressors to seagrass health are related to watershed management (Section 1.1.6.1). These stressors are being addressed under CERP. Restoration targets have been developed and a "desired condition" defined by CERP (Madden et al. 2009). This Seagrass Habitat Restoration Management Plan (SHRMP) more immediately focuses on seagrass stress caused by boating activity. The majority of resource users in Florida Bay are boating fishermen taking advantage of the backcountry experience and the fact that Florida Bay is a premier shallow-water recreational fishing destination. The seagrass resource is responsible for the exceptional fisheries found within Florida Bay. The primary management challenge within ENP lies in allowing these recreational fishing opportunities while protecting natural resources, cultural resources and maintaining wilderness character. To return seagrasses to the desired condition, ENP must implement management strategies to (1) reduce the number of vessel-related impacts, (2) allow recovery of seagrasses in scarred areas through natural re-vegetation or active restoration, and (3) reduce the likelihood of scarring in pristine or relatively unscarred areas (NPS SFNRC 2008). ENP management strategies are discussed in detail in Section 1.1.6.3 above and include resource management (e.g., PTZ and closed areas), law enforcement, education, and improved signage. By implementing these management strategies,

vessel-related impacts to seagrass are reduced which not only benefits the seagrasses but also wilderness character, wildlife, and cultural resources.

A recent study conducted along the east coast of Florida on the Sebastian Inlet flood tidal shoal (Atkins 2012) demonstrated that management of scarring impacts through improved aids to navigation and the marking of shallow areas significantly reduced prop scarring (Figure 13). This study also found that while prop scars were originally distributed randomly over the entire shoal area, via management, they became limited to a few specific areas or "hot-spots" over time (Figure 14). These hot-spots may be investigated and addressed through additional management options.

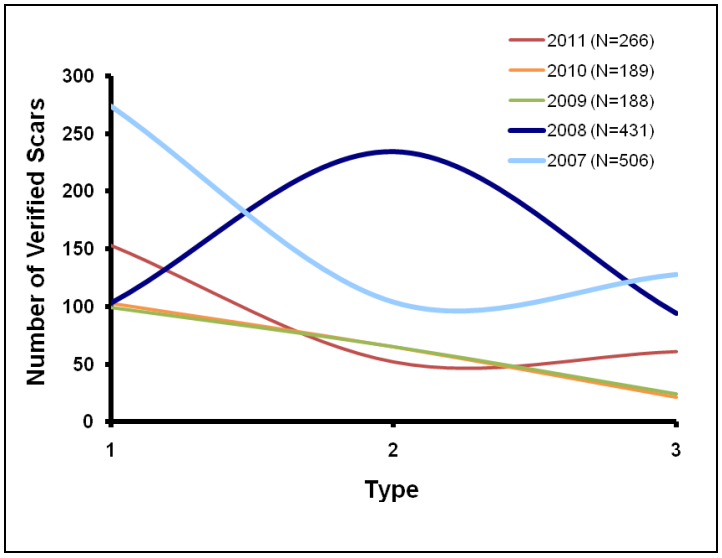

Figure 13. Number of verified prop scars by scar type for 2007 through 2011. Scar types range from 1 (least severe) to 3 (most severe) (Atkins 2012).

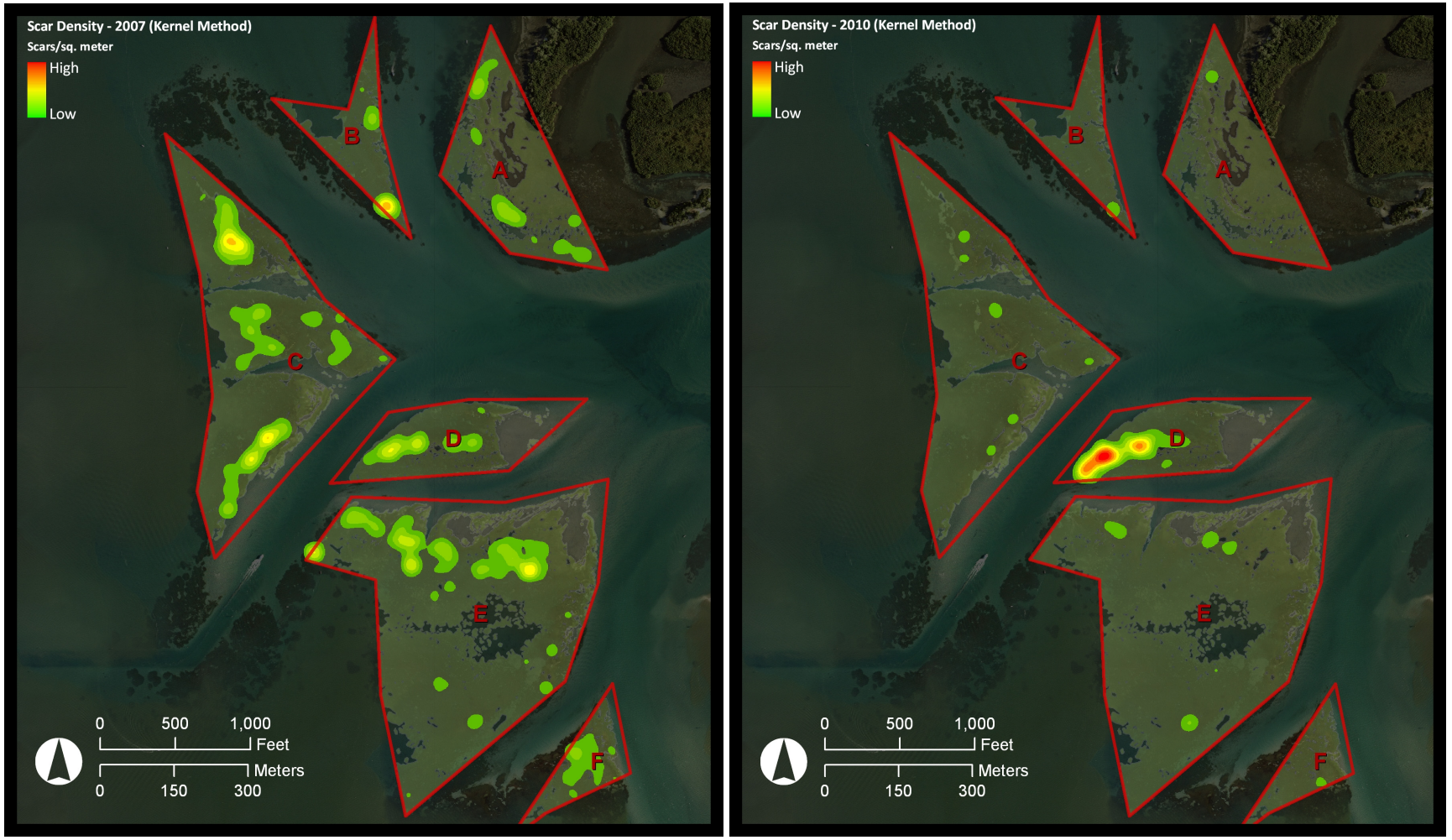

Figure 14. Density of prop scars within the Sebastian Inlet flood tidal shoal mitigation area in 2007 (left) and 2011 (right) (Atkins 2012).

1.1.7 Endangered Species/Critical Habitat

1.1.7.1 Listed Species

A federal agency must insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of threatened and endangered species, nor destroy or adversely modify designated critical habitats for threatened and endangered species (ESA Section 7(a)(2)), Section 1.1.7.2).

Federal protection is designated via an endangered or threatened listing under the 1973 Endangered Species Act (ESA) (16 U.S.C. Sec. 1531-1544), which is administered by the USFWS for terrestrial and freshwater species and the NMFS for marine and anadromous species (an exception being the Florida manatee, *Trichechus manatus latirostris*, which is managed by USFWS). Sea turtles are under the regulatory authority of both agencies, depending on the situation (USFWS for sea turtles nesting on shore, NMFS for sea turtles in the marine environment). In other cases, a species may not be designated as endangered or threatened under the ESA, but receives federal protection under alternate regulations such as the Marine Mammal Protection Act of 1972, the Migratory Bird Treaty Act of 1918, or the Bald Eagle Protection Act of 1940. A distinct population segment may also be listed for vertebrate species. The American crocodile (*Crocodylus acutus*), for example, is listed worldwide as endangered, except in Florida where it has recently been reclassified as threatened due to population recovery (70 FR 15052).

A species listed as "endangered" is considered to be in danger of extinction, while a "threatened" species is considered likely to become endangered within the foreseeable future unless the species and/or its habitat are protected and managed. Furthermore, the state of Florida lists "species of special concern," which are species undergoing consideration for state threatened or endangered listing which do not yet have a state management plan. Florida Administrative Code Chapter 68A-27.005 states "No person shall take, possess, transport, or sell any species of special concern listed in this subsection or parts thereof or their nests or eggs except as authorized by permit from the [FWC] executive director, permits being issued upon reasonable conclusion that the permitted activity will not be detrimental to the survival potential of the species." An example species of special concern relevant to this document would be the Monroe County subpopulation of osprey (*Pandion haliaetus*), which is in the process of being identified as a distinct non-migratory population segment (FFWCC 2013a).

Those species that may be affected by seagrass damage assessment and restoration actions include those that 1) directly use or inhabit seagrass habitat and/or 2) occur in close proximity to seagrass habitat (such as nesting on mangrove islands and shorelines). Species with designated critical habitat in Florida Bay are discussed in Section 1.1.7.2. Nine federally protected species utilize Florida Bay seagrass habitat (Table 1). This list does not include those listed species mentioned in the March 2013 Draft GMP, such as the leatherback sea turtle (*Dermochelys coriacea*), wood stork (*Mycteria americana*), and roseate tern (*Sterna dougallii dougallii*), on the basis that they do not inhabit, feed in, or nest near seagrass beds in Florida Bay. However, this list does include those species designated as Species of Special Concern by the FWC, several of which have been recommended for Threatened status within the state of Florida (FFWCC 2013a,

FFWCC 2013b). The Florida manatee (*Trichechus manatus latirostris*) and green sea turtle (*Chelonia mydas*) utilize seagrass directly as a food source (NPS 2013a). The remainder of the species listed in Table 1 feed on organisms living in or above seagrass beds, including macroalgae, sponges, cnidarians, worms, mollusks, crustaceans, and small fish. Additionally, the bird species listed in Table 1 utilize mangrove islands and/or manmade structures such as channel markers as nesting areas (NPS 2013a, FFWCC 2013a, FFWCC 2013b).

Table 1. Protected species utilizing Florida Bay seagrass habitat.

Common Name	Scientific Name	Listing Status*
Bottlenose dolphin	*Tursiops truncatus*	FP
Florida manatee	*Trichechus manatus latirostris*	FE
American crocodile	*Crocodylus acutus*	FT
Green sea turtle	*Chelonia mydas*	FE
Hawksbill sea turtle	*Eretmochelys imbricata*	FE
Kemp's Ridley sea turtle	*Lepidochelys kempii*	FE
Loggerhead sea turtle	*Caretta caretta*	FT
Smalltooth sawfish	*Pristis pectinata*	FE
Bald eagle	*Haliaeetus leucocephalus*	FP
Piping plover	*Charadrius melodus*	FT
Osprey	*Pandion haliaetus*	SC (Monroe County)
Roseate spoonbill	*Platalea giga*	SC**
Brown pelican	*Pelecanus occidentalis*	SC
Reddish egret	*Egretta rufescens*	SC**
Snowy egret	*Egretta thula*	SC

*FT=Federal Threatened, FE=Federal Endangered, FP=Federal Protected, SC=State Special Concern (16 U.S.C. 1361, FFWCC 2013a, FFWCC 2013b, NPS 2013a, USFWS 2013a).
**Recommended for ST listing (FFWCC 2013b)

The Preferred Alternative identified in the March 2013 Draft GMP includes establishment of a formal seagrass restoration plan, PTZs and idle speed/no wake zones, a mandatory boater education and permitting program, implementation of a detailed boating safety and resource protection plan, implementation of a detailed channel marking and management plan, and increased law enforcement patrols (NPS 2013a).

- The bottlenose dolphin would benefit from the establishment of PTZs, the boater education/permit program, implementation of a detailed channel marking and management plan, and increased law enforcement. The Preferred Alternative would reduce impacts on the bottlenose dolphin, their food sources and their habitats, producing long-term, minor, beneficial impacts on this species.

- While continued motorboat activity and visitor access in the park's marine waters will result in continued, long-term, minor, adverse effects on the manatee, the Preferred

Alternative's new programs and changes in motorboat access will result in reduced boat strikes, decreased underwater noise from motorboats, improved habitat, and moderate benefits to the manatee.

- The piping plover would benefit from the establishment of PTZs and idle speed/no wake zones through reduced disturbance from noise and human activity. The Preferred Alternative would benefit the piping plover and its critical habitat with limited, localized, minor benefits compared to the current management.

- The American crocodile would benefit from the establishment of PTZs and idle speed/no wake zones, the boater education/permit program, and increased law enforcement through reduced disturbance in designated critical habitat and possibly reduced boat strikes. The Preferred Alternative would continue to protect the American crocodile and their habitat and would reduce the likelihood of human-related disturbance.

- Sea turtles would benefit from the establishment of PTZs and idle speed/no wake zones, the boater education/permit program, the detailed boating safety and resource protection plan, increased law enforcement, and the seagrass restoration plan. These programs will result in long-term, minor benefits to sea turtles by reducing the risk of boat strikes and improving seagrass habitat.

- The smalltooth sawfish would benefit from establishment of PTZs and idle speed/no wake zones, the boater education/permit program, the detailed boating safety and resource protection plan, increased law enforcement, and the seagrass restoration plan. These programs will result in long-term, minor benefits to sea turtles by decreasing the risk of injury to sawfish and decreasing degradation of seagrass habitat.

1.1.7.2 Critical Habitat

Critical habitat is defined under Section 4 of the ESA as areas of land, air, and water believed to be essential to the conservation of a species. Florida Bay contains designated critical habitat for four species: smalltooth sawfish (*Pristis pectinata* – 74 FR 45353), American crocodile (*Crocodylus acutus* – 42 FR 47843), Florida manatee (*Trichechus manatus latirostris* – 50 CFR 17.95(a)), and piping plover (*Charadrius melodus* - 66 FR 36107). Figure 15 shows the critical habitat for these species, as well as the American crocodile nesting area.

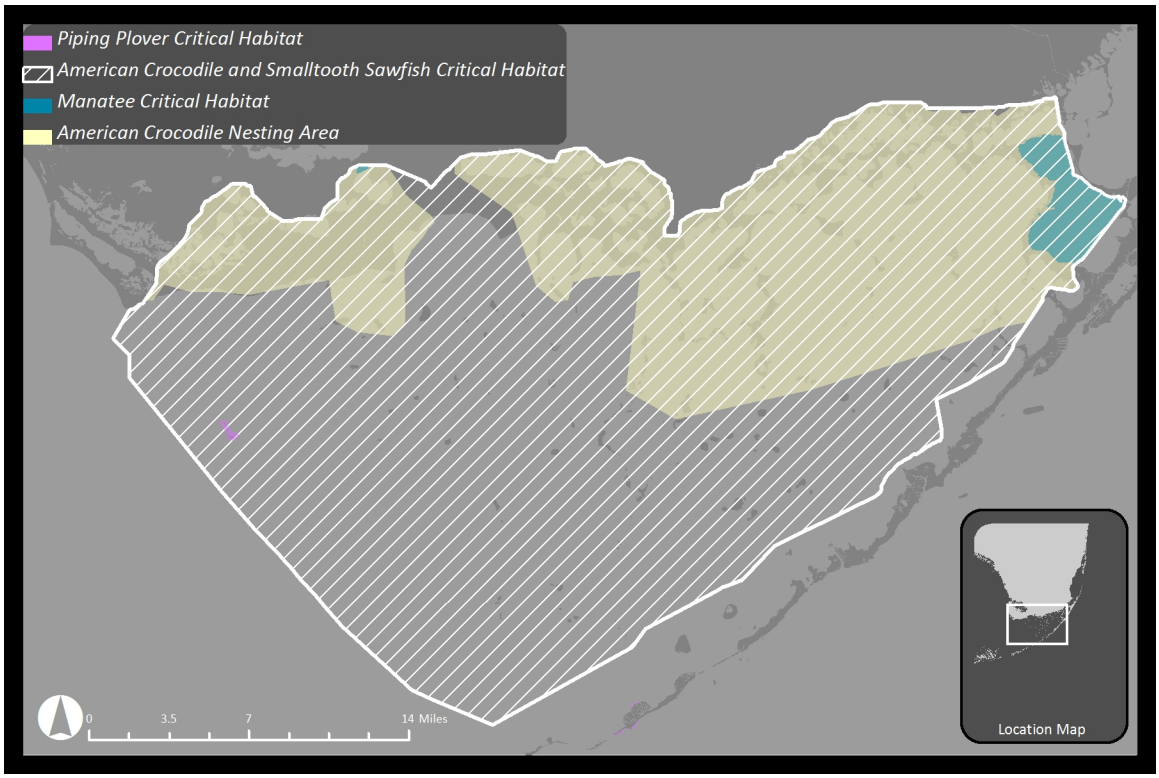

Figure 15. American crocodile, smalltooth sawfish, Florida manatee, and piping plover critical habitat within Florida Bay. Data from USFWS 2001, 2005, and 2010 and NOAA NMFS 2009.

The designated critical habitat for smalltooth sawfish (74 FR 45353) and American crocodile (42 FR 47843) includes all of Florida Bay. Both the smalltooth sawfish and American crocodile are considered the final remaining population of their species in the continental U.S. and are confined to southern Florida. Juvenile smalltooth sawfish are believed to utilize the shallow banks of Florida Bay as a nursery habitat, with the shallow waters providing shelter from large predators such as bull sharks (*Carcharhinus leucas*) and a warm-water environment for optimal growth (Simpfendorfer 2000, Simpfendorfer 2006). American crocodiles utilize the northern shoreline of Florida Bay as a nesting area and are believed to feed in and around seagrass beds, with adult females using the open areas of Florida Bay to access nesting sites (Kushlan and Mazzoti 1989).

The northeastern coastal edges of Florida Bay, including Blackwater and Buttonwood Sounds, as well as a small area of Coot Bay, are designated as critical habitat for the Florida manatee (42 FR 47841). Manatee critical habitat has been confusingly reported by some sources. While some maps show manatee critical habitat designated along the northern shoreline of Florida Bay, this appears to be a misinterpretation of the wording in the Federal Register designation. The southernmost limit of manatee critical habitat on the west coast of Florida is stated as Whitewater Bay, with the next section of the designation being "… all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood Sounds between Key Largo, Monroe County, and the mainland of Dade County …" (42 FR 47841). GIS data maintained by the USFWS shows a small extension of manatee critical habitat from Whitewater Bay into Tarpon

Creek and the northernmost part of Coot Bay. Although this area is removed from, and only connected to Florida Bay by Buttonwood Canal, it is included in Figure 15. In addition to their dependence on seagrass beds as a food source, manatees will utilize shallow coastal waters as a thermal refuge during the winter (NPS 2013a).

Approximately 165 acres surrounding Sandy and Carl Ross Keys in Florida Bay are designated as critical habitat for the wintering population of piping plover. This critical habitat includes land from mean lower low water to the landward edge of seagrass (66 FR 36107). Though piping plovers do not directly utilize seagrasses, they occur in close proximity, foraging on exposed wet sand in wash zones, sand-flats, or within rack lines (USFWS 2013b).

1.1.7.3 Issues of Concern

Individuals of protected species may range over wide areas, as they are not dependent on a specific seagrass area. However, loss of or damage to seagrasses over a large area will affect the habitat resources available to endangered and protected species. All project personnel performing damage assessment, restoration, or monitoring protocols described in this SHRMP should be instructed in standard measures as required by ENP to avoid impacts to manatees, sea turtles, or smalltooth sawfish (Section 6.2.2).

1.1.8 Essential Fish Habitat and Habitat Areas of Particular Concern

EFH refers to waters and substrate necessary to fish for spawning, breeding, feeding, or growth. Under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act ; Public Law 94-265, as amended), the NMFS works with the regional Fishery Management Councils to develop Fishery Management Plans for each fishery under their jurisdiction. Each Fishery Management Plan identifies EFH for every life stage of each federally-managed species in that fishery. See Section 9.7 for additional information. NMFS and the Fishery Management Councils also identify Habitat Areas of Particular Concern (HAPC), which are defined as an EFH subset that is scarce, highly susceptible to anthropogenic degradation, ecologically important, or in an environmentally-stressed area. HAPCs are considered high priority areas for conservation, management, and research.

Federal agencies are required to consult with NMFS when authorizing, funding, or conducting any activities which may adversely affect EFH. ENP has conducted coordination with the NMFS regarding the proposed SHRMP. In a letter dated March 15, 2013 (Appendix A), NMFS indicates that the South Atlantic Fishery Management Council and the Gulf of Mexico Fishery Management Council have identified seagrass as EFH for several managed species occurring within the project area, such as the adult white grunt (*Haemulon plumieri*), juvenile and adult gray snapper (*Lutjanus griseus*), and juvenile mutton snapper (*Lutjanus analis*). The NMFS letter also indicates that Florida Bay has been designated as a HAPC for several species within the snapper/grouper complex.

The NMFS letter concurs with ENP's determination that implementation of the proposed Florida Bay SHRMP will have a beneficial effect on EFH. NMFS also requested that the SHRMP include several Best Management Practices (BMPs) to avoid potential adverse impacts and to monitor restoration performance. These BMPs have been incorporated into the SHRMP.

The Preferred Alternative identified in the March 2013 Draft GMP includes a formal seagrass restoration program, mandatory boater education and permitting program, and establishment of PTZs and idle speed/no wake zones (NPS 2013a). These new programs and changes in motorboat access will result in substantial improvements to the health and functioning of benthic habitat and will create long-term, moderate beneficial impacts to shallow-water habitats (NPS 2013a).

1.1.9 Wilderness

1.1.9.1 Wilderness Legislation

Wilderness Act of 1964

On September 3, 1964, Congress established the Wilderness Act (Public Law 88-577; 16 U.S. C. 1131-1136), which designated specific federally owned areas as "wilderness areas" to be administered, preserved, and protected for present and future generations of Americans. Wilderness areas are briefly defined as designated areas of Federal land that retain primeval character and influence, without permanent improvements or human habitation (the legal definition of "wilderness" is provided in Section 9.1). According to the Wilderness Act, "wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use." The Wilderness Act established the National Wilderness Preservation System and identified the NPS as one of the four federal agencies responsible for the protection and preservation of the nation's wilderness resources. Section 9.1 of this document provides additional information regarding the Wilderness Act.

ENP Wilderness Act of 1978 – MSD Wilderness Area

Congress designated the Everglades Wilderness on November 10, 1978 under the National Parks and Recreation Act of 1978 (Public Law 95-625), in accordance with section 3(c) of the Wilderness Act (78 Stat. 890; 15 U.S.C 1132(c)). The Everglades Wilderness is the largest wilderness area east of the Rocky Mountains (NPS General Management Plan Newsletter One) and includes approximately 1,269,500 acres, as well as approximately 81,900 acres of potential wilderness additions (to become wilderness when prohibited uses cease). The ENP's Everglades Wilderness Description of Boundaries, dated May 1981 (NPS 1981), provides a textual description of those lands and submerged lands included in the Everglades Wilderness. On November 22, 1989, Congress passed the ENP Protection and Expansion Act of 1989 (Public Law 101-229), adding approximately 109,600 acres to the ENP, including the Northeast Shark River Slough and the East Everglades.

On November 13, 1997, the National Parks and Recreation Act of 1978 was amended to redesignate the Everglades Wilderness as the MSD Wilderness (Public Law 105-82). The redesignation was enacted to recognize and commemorate the contributions of Mrs. Douglas in Everglades protection and the establishment of ENP. The MSD Wilderness includes 1.3 million acres of ENP and is managed under the terms of the Wilderness Act of 1964 and the ENP Wilderness Act of 1978. The NPS is responsible for managing the MSD Wilderness. While nearly all of Florida Bay located within the ENP is designated as wilderness, ENP's jurisdiction

also includes a 1/8th mile-wide strip of non-wilderness area adjoining the Intracoastal Waterway (NPS SFNRC 2008). Figure 1 shows the boundaries of the MSD Wilderness.

The March 2013 Draft GMP identified a Preferred Alternative that proposes the designation of an additional ~80,100 acres as wilderness, as well as ~9,900 acres within the East Everglades Expansion Area as potential wilderness.

1.1.9.2 Wilderness Character and Wilderness Management

Wilderness Character

It is the responsibility of the NPS to manage and preserve the wilderness character of the MSD Wilderness. The Wilderness Act does not provide a definition of wilderness character; however, the report from the Interagency Wilderness Character Monitoring Team, titled *Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al. 2008), defines wilderness character as "the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands." This document also identifies the following four tangible qualities of wilderness character, which are equivalent in terms of importance and are both relevant and practical to managing wilderness.

- *"**Untrammeled*** - The Wilderness Act states that wilderness is 'an area where the earth and its community of life are untrammeled by man,' and 'generally appears to have been affected primarily by the forces of nature.' In short, wilderness is essentially unhindered and free from modern human control or manipulation. This quality is degraded by modern human activities or actions that control or manipulate the components or processes of ecological systems inside the wilderness."

- ***"Natural*** - The Wilderness Act states that wilderness is 'protected and managed so as to preserve its natural conditions.' In short, wilderness ecological systems are substantially free from the effects of modern civilization. This quality is degraded by intended or unintended effects of modern people on the ecological systems inside the wilderness since the area was designated."

- *"**Undeveloped*** - The Wilderness Act states that wilderness is 'an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation,' 'where man himself is a visitor who does not remain' and 'with the imprint of man's work substantially unnoticeable.' This quality is degraded by the presence of structures, installations, habitations, and by the use of motor vehicles, motorized equipment, or mechanical transport that increases people's ability to occupy or modify the environment."

- *"**Solitude or a primitive and unconfined type of recreation*** - The Wilderness Act states that wilderness has 'outstanding opportunities for solitude or a primitive and unconfined type of recreation.' This quality is about the *opportunity* for people to experience wilderness; it is not directly about visitor experiences per se. This quality is degraded by

settings that reduce these opportunities, such as visitor encounters, signs of modern civilization, recreation facilities, and management restrictions on visitor behavior."

The Wilderness Act dictates that certain activities are generally prohibited within wilderness areas (i.e., no commercial enterprise, construction of permanent or temporary roads, installation of structures, or use of mechanical vehicles). Use of motorized equipment/transportation is authorized within wilderness only under the following circumstances:

- The superintendent determines that use is the minimum requirement needed to achieve the purposed action, including preservation of the wilderness character and values, in accordance with the Wilderness Act.

- Emergencies involving the health and safety of persons within the wilderness area (e.g., search and rescue, law enforcement, homeland security).

NPS Management Responsibilities and Policies

There are several documents that have been created by the NPS to provide clarification and insight regarding the NPS policies and guidelines for adherence to the Wilderness Act. The National Wildlife Steering Committee (NWSC) is an advisory body within the NPS that is comprised of NPS staff and was created to assist the Director and the parks with improving NPS wilderness stewardship. Information regarding the NPS's wilderness responsibilities was obtained from the following documents.

- The 2006 NPS Management Policies (NPS 2006), Chapter 6: Wilderness Preservation and Management;

- Reference Manual (RM) 41 (NPS 1999): Wilderness Preservation and Management (includes Director's Order #41 *Wilderness Stewardship*, revised May 13, 2013);

- NWSC Guidance White Paper Number 2: What Constitutes Appropriate Conservation and Restoration in Wilderness? (NWSC 2004); and

- NWSC Guidance White Paper Number 3: What Constitutes the Minimum Requirements in Wilderness? (NWSC 2006).

It is ENP's responsibility to manage the Florida Bay bottom within the MSD Wilderness (i.e., the Federal submerged lands are included in the wilderness designation, but the water above is excluded). Director's Order #41 (see Section 9.14.3 for additional detail), together with Reference Manual 41 (NPS 1999), establishes management responsibility and accountability for NPS wilderness managers. Director's Order #41 states:

> *"Wilderness character is the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. The five qualities of wilderness character are (1) untrammeled, (2) undeveloped, (3) natural, (4) offers outstanding opportunities for solitude or primitive and unconfined recreation, and (5) other features*

of scientific, educational, scenic, or historic value. Accordingly, each wilderness park will integrate the concept of wilderness character into park planning, management, and monitoring in order to preserve the enduring benefits and values of wilderness for future generations.

Whenever a park planning process that has the potential to affect wilderness character occurs, the park should determine how wilderness character can be both integrated into the planning effort and presented in the planning document."

Minimum Requirement/Activity

Section 4 (c) of the Wilderness Act states:

"…except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing f aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Director's Order #41 requires that park managers establish a Minimum Requirements Analysis (MRA) (NPS 2013c). The intent of the minimum requirement concept is to guide management actions within wilderness area in order to minimize impacts to wilderness resources and character. All NPS administrative actions, projects, or programs affecting a wilderness area must be consistent with the concept of "minimum requirement" (NPS 1999, NPS 2006). The minimum requirement is a documented two-step process that allows the NPS to ensure that:

- The proposed management decision is "appropriate and necessary" in the administration and stewardship planning of the wilderness area, and that the action does not significantly impact with wilderness resources and character.

- Any techniques and equipment needed to carry out the action will be selected to minimize any impacts on wilderness resources and character (minimum tool).

Minimum Tool. The technique/method selected to carry out the action must represent the "minimum tool" to achieve the project. Director's Order #41 distinguishes the difference between the Minimum Requirement and the Minimum Tool. The Minimum Requirement is a documented process used by the NPS to determine whether an action that will affect a wilderness area is appropriate. Once an action is determined to be appropriate under the Minimum Requirement, the Minimum Tool represents the least intrusive method (i.e., tool, equipment, device, force, regulation, or practice) to achieve the action.

The NWSC's *Guidance White Paper Number 3: What Constitutes the Minimum Requirements in Wilderness?* (NWSC 2006) describes the NPS decision-making process to determine the appropriateness of proposed administrative actions. The minimum requirement is a documented two-step process.

Step One: The proposed management decision must be both "appropriate and necessary" in the administration and stewardship planning of the wilderness area. Consideration must be made as to whether the overall benefits of the action outweigh the potential impacts to wilderness character. A proposed action, if taken, should leave the area unimpaired for future use and enjoyment as a wilderness. The NWSC *Guidance White Paper Number 3* provides NPS managers with a series of filter/screening questions to aid in evaluating the necessity of a proposed action (Section 4.7.2).

Step Two: In the event that park managers determine that a proposed action is appropriate and necessary, any techniques and equipment needed to carry out the action will be selected with the goal of minimizing impacts to wilderness resources and character (i.e., minimum activity). Only those actions will be selected that preserve wilderness character and/or have minimal, localized, short-term impacts. Managers should identify the least intrusive tool, equipment, device, force, regulation, or practice that will achieve the action and concurrently honor the purpose of the Wilderness Act. If an action can be accomplished without the use of any of the Section 4c(c) prohibitions (i.e., no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area), then that method would serve as the minimum activity. Otherwise, some overriding factor would be required to warrant an exception to the Section 4c(c) prohibitions. According to the NWSC *Guidance White Paper Number 3*, such overriding factors would include:

- A human health and safety emergency within a wilderness area;

- The minimum action "necessary to manage the area for the purpose of the Wilderness Act which preserves its wilderness character and for such other purposes for which it was established , and cannot be performed without the use of a Section 4 (c) exemption"; and

- The minimum action "necessary to manage the area for the purpose of the Wilderness Act which preserves its wilderness character and for such other purposes for which it was established, and the use of one of the Section 4 (c) exemptions has fewer impacts on wilderness character, resources, and purposes than the prohibited use method of performing the work.

A technique/method selected to carry out the action must clearly demonstrate the benefits/impacts of the selected method, document the decision-making process, and be supported in a supporting environmental compliance document. The park must complete an analysis of the administrative actions and associated equipment needs that could potentially impact wilderness resources and character.

In the event that a decision is made that will have an unavoidable adverse impact on wilderness resources and/or character, only those actions will be selected that preserve wilderness character and/or have minimal, localized, short-term impacts. The management of wilderness according to the "minimum requirement" concept may incur additional costs (e.g., money, time, and/or labor).

However, in NPS decision making, the minimum concept takes priority over the issues of economic efficiency and/or convenience. The NWSC *Guidance White Paper Number 3* provides guidance for NPS staff regarding selection of the appropriate minimum action with regard to weighing the cost and efficiency of activities.

While all management decisions affecting wilderness must consider the minimum requirement concept, a documented MRA is required for any administrative action that 1) proposes any of the prohibited uses listed in Section 4 (c) of the Wilderness Act (see above), 2) has the potential to impact wilderness resources or values, or 3) is identified by other sections of Chapter 6 of the NPS management policies.

1.1.9.3 Issues of Concern

The NPS has the complex task of maintaining wilderness areas for the purposes of public recreational, scenic, scientific, educational, conservation, and historical use, while concurrently preserving wilderness character and value. Managers of the MSD Wilderness must preserve the submerged wilderness (Florida Bay bottom**)** while concurrently providing for continued public use of the overlying water (e.g., recreational use with motorized vessels). As mentioned previously, Florida Bay experiences heavy recreational boat use and the shallow nature and complex landscapes of the bay leave its benthic habitats susceptible to damage from motorized watercraft. In cases where damage is extensive (e.g., large events or repetitive small damages over time), such damages degrade the natural and wilderness resources. This impacted wilderness may benefit from conservation and restoration efforts and activities which may ultimately result in a more fully functioning ecosystem with enhanced natural quality of wilderness character (NWSC 2004). Such restoration efforts/activities also have the capacity to result in adverse impacts to wilderness character that vary both in magnitude and longevity (NWSC 2004). Thus, the NPS must carefully assess any restoration action to ensure that it is consistent with NPS wilderness management policies.

1.1.9.4 Desired Conditions

The Wilderness Act specifies that wilderness "generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable, and has outstanding opportunities for solitude or a primitive and unconfined type of recreation." While the Wilderness Act sanctions limited human activity of wilderness areas, unavoidable impacts are associated with human use (Roggenbuck and Watson 1993). The Wilderness Act allows for a limited amount of change from a pristine nature with its use of such terms as "generally," "primarily," and "substantially" (Hendee et al. 1990). Traditionally, resource managers have attempted to protect the wilderness resource and experience through efforts to define the carrying capacity of an area. Such attempts have, at times, resulted in estimates of appropriate levels of use and in efforts to limit use (Roggenbuck and Watson 1993). As discussed in Director's Order #41 and Reference Manual 41, the wilderness character planning framework currently instituted for ENP requires that any action conducted within a wilderness must result in an overall benefit (or no change) to wilderness character (per the minimum requirement concept).

The wilderness resources of Florida Bay include large and remote expanses of natural, undeveloped habitat, extensive seagrass beds, abundant bird populations, and a shallow-water

recreational fishery that is a premier fishing and wildlife viewing destination for national and international visitors. The majority of the visitors to Florida Bay are boating fishermen and observers taking advantage of the wilderness experience, wildlife viewing, and the exceptional shallow-water recreational fishing opportunities. The primary management challenge within Florida Bay lies in allowing for recreational fishing and wildlife opportunities, which can result in damages to benthic habitats from motorized watercraft within Florida Bay. As discussed in Section 1.1.6, seagrass communities are integral to the ecological function of Florida Bay and provide food and shelter necessary to sustain the exceptional fisheries and bird populations found within the bay. Florida Bay's healthy recreational fisheries contribute to the wilderness character and wilderness experience within the park. A change in the health of the bay's seagrasses would affect the fishery and, eventually the quality of the fishing and wildlife viewing experience.

The March 2013 Draft GMP identified the following desired conditions with regard to wilderness:

> *"Wilderness areas retain their wilderness characteristics and values. Visitors find opportunities for primitive recreation and solitude. Wilderness areas are affected primarily by the forces of nature, and signs of people remain substantially unnoticeable."*

The untrammeled, natural, undeveloped, and primitive/unconfined qualities of wilderness character will be positively and negatively impacted by the Preferred Alternative identified in the March 2013 Draft GMP. The Preferred Alternative would have a moderate, long-term, beneficial impact to wilderness character in the Florida Bay submerged wilderness from establishment of the PTZs, idle speed/no wake zones, and mandatory boater education and permitting program. The untrammeled quality of submerged wilderness will be adversely impacted by the implementation of a formal seagrass restoration program. These impacts will be short-term, localized, and on a minor-to-moderate scale. The natural quality of submerged wilderness will benefit over the long-term from the formal seagrass restoration program (localized, minor-to-moderate benefits) and PTZs, idle speed/no wake zones, and mandatory boater education and permitting program (regional, moderate-to-major benefits). The installation of navigational aids will have long-term, negligible to minor, adverse impacts to the undeveloped quality of submerged wilderness. The primitive/unconfined quality of submerged wilderness will be positively and negatively impacted by the Preferred Alternative. The establishment of PTZs and idle speed/no wake zones will slightly benefit the primitive/unconfined experience by reducing noise disturbances on a long-term, localized scale. However, PTZs and the mandatory boater education and permitting program will adversely affect the primitive/unconfined sense of solitude because it will restrict boater access to certain areas of Florida Bay. This will result in a long-term, regional, moderate impact (NPS 2013a).

1.1.10 Cultural Resources

1.1.10.1 Cultural History Overview

Southern Florida has been inhabited by humans at least since the last ice age 14-15,000 years ago; when sea levels were substantially lower (Clausen et al. 1979). Much of Florida Bay's

current benthic environment would have been exposed and potentially accessible at the time; however subsequent inundation around 6,500 years ago was slow and would have exposed remains and artifacts to environmental degradation (NOAA and FDEP 2004). With that caveat stated, Paleo-Indian artifacts have been recovered from an inundated coastal site in Florida, the Douglass Beach Midden (Murphy 1990). Most of what we know of Paleo-Indian habitation in south Florida comes from artifacts recovered from submerged anoxic environments such as sinkholes, which have yielded artifacts dating back at least 12,000 years (Clausen et al. 1979). Around 6,500 years ago, the environment switched from arid plains to a wetter environment which, coupled with the prior extinction of large game animals, gave rise to Archaic-period peoples more dependent on fixed camps and small game than their nomadic ancestors (McCally 1999). The rise of water tables to modern-day levels around 3000 B.C. led to the succession of Glades cultures, characterized by increasingly intricate pottery, tools, shell ornaments and mounds, and earthworks (Goggin 1947). One particular feature (designated as a National Historic Site in 2006) created between 750 and 1250 A.D. is the Mud Lake Canal, an excavated 3.9-mi canoe passage connecting the Ten Thousand Islands region and Whitewater Bay directly to Florida Bay (NPS 2013a).

European explorers are first known to have made contact with Florida natives in 1513 A.D., at which time the Florida Bay region was inhabited by the Calusa to the far west and the Tequesta along the northern shoreline (Griffin 2002). Neither society appears to have lived extensively in the Everglades, with the Calusa centered at the mouth of the Caloosahatchee River and the Tequesta centered in the present-day Miami area (McCally 1999). Both utilized the marine environment using canoes to: (1) catch fish, shellfish, and manatees throughout the coastal regions, (2) salvage wrecked Spanish ships, and (3) travel as far as the Florida Keys and Cuba (McCally 1999, Griffin 2002). Both the Calusa and Tequesta were largely wiped out by the early 18th century, with some survivors being transported to Cuba and other presumably making up part of what would become the Seminole people, who moved into the area in the mid-1700s and absorbed the remnants of Florida's pre-Colombian civilizations (Tebeau 1968, Milanich 1998). The 1814-1818 U.S. incursions into then Spanish-held Florida led to a series of conflicts with the Seminoles, which pushed the tribe farther south into the Everglades (New South Associates 2010). The Second and Third Seminole Wars resulted in the exploration and mapping of the area (including construction of Fort Cross at Cape Sable) until the end of the Third Seminole War in 1859, after which the Seminoles were largely undisturbed until the construction of the Tamiami Trail from 1928 to 1930 (NPS 1979, NPS 2013a). Chokoloskee, Cape Sable, and Flamingo were settled late in the 19th century by farmers, hunters, fishermen, and traders. A key industry at Flamingo was the manufacture of charcoal for shipping to Key West (NPS 2013a).

1.1.10.2 Cultural Resources in Everglades National Park and Florida Bay

While archeological investigations within the Everglades region began in the late 1930s, there have only been two major archeological surveys completed within ENP. A comprehensive survey of ENP was conducted in 1982-1984 by the NPS Southeast Archeological Center (SEAC). This survey resulted in the listing of 196 archeological sites within the boundaries of ENP in the National Register of Historic Places (NRHP). The second survey, conducted in 2004-2005 by the SEAC to investigate archeological resources within the Eastern Everglades

Expansion Area portion of ENP (see Section 9.11 for additional detail), identified and recorded 42 additional archeological sites within the Eastern Everglades Addition. In addition, an investigation is currently underway by SEAC, the NPS office of the NRHP, and the Florida State Historic Preservation Office (SHPO) to investigate prehistoric shell works sites in the area of the Ten Thousand Islands. The resources include middens (refuse piles) and shell or earthen works and mound features containing artifacts. There are currently no known Paleo-Indian sites within ENP (New South Associates 2010, NPS 2013a) and the oldest sites presently identified within ENP (located in the East Everglades Expansion Area) date back to the Middle Archaic period (5000-3000 B.C.) (NPS 2013a).

There are several historic structures designated with ENP including Old Ingraham Highway and its associated canals, the Nike Missile Base Site HM-69, the Town of Flamingo, Other Mission 66 buildings and structures, the East Everglades Island Camps, and the Tamiami Trail and airboat operations (NPS 2013a). No historic structures have currently been identified within Florida Bay.

There is currently a considerable lack of knowledge regarding cultural resources within Florida Bay. However, a project is underway by the University of Miami's Rosenstiel School of Marine and Atmospheric Science and the NPS Climate Change Adaptation Program to develop a site probability model for Florida Bay submerged prehistoric sites. This model is based on identification of submerged features that may represent sites of past terrestrial human occupations inundated during the transgression that occurred during the transition to the Holocene. The model includes interpretation of karst features, buried peat layers, and potential archeological features such as shell middens. It is anticipated that testing and refining of the model will enable ENP to focus site identification efforts on areas of higher site potential.

Under the Wilderness Act, the NPS is responsible for the management of cultural resources located within wilderness areas (NWSC 2002). Cultural resources include archeological resources, cultural landscapes, structures, museum objects and ethnographic resources (NPS 1998a). While the NPS must comply with the provisions of the Wilderness Act with regard to preserving cultural resources, the Wilderness Act does not supersede or override other historic preservation laws, e.g., Antiquities Act of 1906, Historic Sites Act of 1935, National Historic Preservation Act (NHPA), Archeological Resources Preservation Act, Native American Graves Protection and Repatriation Act (NAGPRA), and American Indian Religious Freedom Act (NPS 1999, NWSC 2002). NPS Reference Manual 41 states that Native American religious areas and other ethnographic and cultural resources should be inventoried and protected (NPS 1999). ENP management maintains intergovernmental consultation with the Miccosukee Tribe of Indians of Florida, the Seminole Tribe of Florida, and the Seminole Nation of Oklahoma. ENP also consults with the Independent Traditional Seminole Nation of Florida on matters of ethnographic resources within ENP (NPS 2013a). The Miccosukee Tribe of Indians of Florida claim cultural affiliation with the Calusa Indians and retain repatriation interests for Calusa cultural materials. The minimum requirement activity applies to cultural resource activities within wilderness (NWSC 2002).

1.1.10.3 Issues of Concern

It is important to preserve cultural resources because they have the potential to advance public knowledge and understanding of history, the indigenous way of life, and the ways in which cultures adapted and interacted within the Everglades region (NPS 1996). While civilizations are known to have inhabited the area, to date nothing is known regarding cultural resources within Florida Bay or submerged resources that may lie on the bay bottom (NPS 1979, NPS 2013a). Given the known history of human habitation and maritime activity in the area, as well as that our best knowledge of prehistoric Florida cultures comes from artifacts preserved in anoxic sediments, it is possible that exposure of a submerged cultural resource may occur as a result of a vessel grounding.

1.1.10.4 Desired Conditions

The March 2013 Draft GMP identified the following desired conditions with regard to cultural resources, historic structures, cultural landscapes, archeological resources, and ethnographic resources:

> *Cultural Resources: "Cultural resources are identified, evaluated, managed, interpreted, and protected within their broader context. Management decisions about cultural resources are based on scholarly research and scientific information and consultation with the Florida SHPO and with American Indian tribes, and other groups with historic connections to the park, as appropriate. The historic integrity of properties listed in (or eligible for listing in) the NRHP is protected. Visitors and employees recognize and understand the value of the park's cultural resources. Human and natural impacts on cultural resources are monitored, and adverse effects are minimized or eliminated."*
>
> *Historic Structures: "The character of historic structures is preserved to retain a high degree of integrity. Whenever possible, adaptive use of historic structures for park needs is considered before building new infrastructure."*
>
> *Cultural Landscapes: "ENP's cultural landscapes are preserved to retain a high degree of integrity. (Cultural landscapes reflect human adaptation and use of natural resources and are often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built.)"*
>
> *Archeological Resources: "Archeological resources are identified and preserved. (Archeological resources are the remains of past human activity and records documenting the scientific analysis of these remains. Archeological features are typically buried, but may extend above ground. Although archeological resources are commonly associated with prehistoric peoples, they may also be products of more recent historical activities.) Archeological sites may also represent or be components of historic structures and cultural landscapes."*
>
> *Ethnographic Resources: "Ethnographic resources having cultural importance for associated tribes and other traditionally associated groups are identified and protected. Opportunities remain for tribal members and traditionally associated people to access*

*culturally important places in the park. Ethnographic resources are defined by the NPS as any 'site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it' (*NPS 28, *Cultural Resource Management Guideline, 181)."*

1.2 PARK MANAGEMENT AND CONTEXT FOR FLORIDA BAY SEAGRASS RESTORATION

1.2.1 General Management Plan

Development of a GMP is required for all National Parks. The GMP provides park managers with focus, guidance, and direction with regard to resource management, general development, and administration. ENP has recently released the March 2013 Draft GMP. The purpose of the GMP is to guide long-term decisions (i.e., over the next 20 years) regarding the management and protection of park resources, visitor activities, and facility development within ENP. The GMP addresses issues that are critical to appropriately manage ENP and Florida Bay (NPS 2006).

The desired resource conditions within Florida Bay and ENP were presented in the March 2013 Draft GMP. The desired conditions for many of these resources were presented previously in this document, including water quality (Section 1.1.4.2), natural resources and biological diversity (Section 1.1.5.6), wildlife (Section 1.1.5.6), fisheries (Section 1.1.5.6), vegetation (Section 1.1.6.4), wilderness (Section 1.1.9.4), cultural resources (Section 1.1.10.4), historic structures (Section 1.1.10.4), cultural landscapes (Section 1.1.10.4), archeological resources (Section 1.1.10.4), and ethnographic resources (Section 1.1.10.4). The desired conditions for ecosystem management, visitor use and experience, viewsheds and vistas, and natural soundscapes, as defined in the March 2013 Draft GMP, are presented below:

<u>Ecosystem Management</u>: "Marine, estuarine, freshwater, and terrestrial habitats are managed from an ecosystem perspective, considering both internal and external factors affecting visitor use, environmental quality, and resource stewardship. Management decisions about ecosystems are based on scholarly and scientific information. Resources and visitation are managed in consideration of the ecological and social conditions of the national park and surrounding area. NPS managers adapt management strategies to changing ecological and social conditions and are partners in regional land planning and management. NPS staff demonstrates leadership in resource stewardship and conservation of ecosystem values."

<u>Visitor Use and Experience</u>: "Visitors from diverse backgrounds can experience a range of opportunities consistent with the purpose and significance of the national park. Most visitors understand and appreciate the purpose and significance of the national park and value their stewardship role in preserving natural and cultural features. They actively contribute to the park's preservation through appropriate use and behavior. Park programs and services are accessible to all and conflicts between different user groups are minimized. Visitor use levels and activities are consistent with preserving park purpose and significance, and with providing opportunities for recreation, education, and inspiration. Management decisions are based on scholarly and scientific

information. When such information is lacking, managers make decisions based on the best available information, adapting as new information becomes available. Regional recreational opportunities continue to be coordinated among agencies for public benefit and ease of use."

Viewsheds and Vistas: "Natural vistas and cultural landscapes provide park visitors with an immediate and lasting sensory experience that strongly conveys the character of the national park. Key scenic vistas are identified and protected. Park managers work with neighbors, local communities, and land managers to preserve scenic values."

Natural Soundscapes: "Natural soundscapes, which are important to many vertebrate and invertebrate species, are preserved. (For example, bats and dolphins use reflected sound waves (echolocation) to navigate and to locate prey; frogs, birds, and insects rely on natural sounds to find mates or avoid predators.) Visitors have opportunities in most areas of the park to experience natural sounds."

The Preferred Alternative identified in the March 2013 Draft GMP will aim to support restoration of natural systems within ENP, while concurrently improving the quality and opportunities for park visitors. The Preferred Alternative includes establishment of a formal, comprehensive seagrass restoration program for Florida Bay, a submerged marine wilderness. Furthermore, the Preferred Alternative includes development of a boating safety and resource protection plan which will evaluate means to reduce collisions between boats and boats and wildlife as well as vessel impacts to the bay bottom (groundings, prop scarring, blow holes). This SHRMP provides technical guidance for ENP staff and managers regarding seagrass restoration and monitoring actions. This SHRMP will support the proposed ENP seagrass restoration program.

1.2.2 Existing Management Programs/Methods within Everglades National Park

This section discusses the existing management plans, programs, measures, and projects in place under various authorities that impact or include Florida Bay.

1.2.2.1 Comprehensive Everglades Restoration Plan

The Water Resources Development Acts of 1992 and 1996 granted authority for funding of the CERP in 2000, which includes a series of water system improvement projects intended to restore and preserve the Everglades and the south Florida region. Florida Bay is one component of the greater south Florida ecosystem that will be impacted by the CERP. As discussed in Section 1.1.4, ENP is part of a massive freshwater system that historically discharged into Florida Bay. Human alterations during the 20th century have altered the input and output flow patterns, salinities, and nutrient levels within Florida Bay.

Implementation of the CERP is intended to "reduce the intensity, frequency, duration, and spatial extent of hypersaline events in Florida Bay and establish a persistent and resilient estuarine zone that extends further into the bay than currently exists. This is expected to improve the production of bay flora and fauna and increase biomass and diversity in the bay at large" (RECOVER 2012). The *Southern Coastal Systems Performance Measures - Salinity in Florida*

Bay, accepted in June 2012 (RECOVER 2012), lists the following CERP salinity restoration goals for Florida Bay:

- Restore oligohaline to mesohaline salinity patterns in the nearshore environment;
- Lower the average salinity in the bay;
- Reduce the frequency, duration, magnitude, and spatial extent of hypersaline (> 40 psu) conditions throughout the bay; and
- Restore seasonal deliveries of freshwater more typical of the natural system, e.g., extension of water deliveries into the dry season.

The document also presents the specific CERP salinity metrics and targets for Florida Bay.

1.2.2.2 Central Everglades Planning Project

In 2011, the Central Everglades Planning Project (CEPP) was initiated, which includes a series of projects designed to increase water deliveries to the central Everglades and ENP. The plan also includes reducing water discharges to the Atlantic Ocean and Gulf of Mexico and restoration of Everglades habitat. The CEPP includes implementation of several projects originally included in CERP in order to expedite completion of these projects and benefit ENP sooner than originally planned (USACE and SFWMD 2013).

1.2.2.3 Seagrass Management and Protection Measures.

The issue of seagrass damage associated with shallow water boating within Florida Bay has led to the implementation of various seagrass management and protective measures, including the following (Section 1.1.6.3 provides additional discussion on each of these protection measures):

- Establishment of a PTZ in Snake Bight to protect seagrasses and wilderness character and to enhance the visitor experience within this portion of the park (NPS 2011);
- Prohibition of entry into specific areas of Florida Bay (under the Everglades Compendium) to offer additional protection to wildlife habitat;
- Implementation of law enforcement measures (e.g., investigation and potential prosecution for boat grounding incidents) to protect submerged aquatic resources within Florida Bay (NPS 2006);
- Public education pertaining to Florida Bay seagrass resources achieved through visitor activities, interpretive media, scholarly research, and public input; and
- Installation of improved signage/marking to minimize impacts to seagrass resources within Florida Bay.