UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

F/SER31: AL

MAY 03 2017

Chief, Miami Section
Jacksonville District Corps of Engineers
Department of the Army
9900 Southwest 107 Avenue, Suite 203
Miami, Florida 33176

Dear Sir or Madam:

Enclosed is the National Marine Fisheries Service's (NMFS) Biological Opinion on the U.S. Army Corps of Engineers, Jacksonville District's (USACE) proposed action to issue a regulatory permit to (1) Mr. Robert Diener to remove and replace a 413-square-foot dock and install 2 boatlifts; (2) Upper Eastside Miami, LLC to construct a 12-slip marina; and (3) 158 Palm, LLC to construct a 380-square-foot dock. All 3 projects are located in Miami-Dade County, Florida.

This Opinion analyzes the potential for the projects to affect sea turtles (loggerhead, leatherback, Kemp's ridley, hawksbill, and green), smalltooth sawfish, Johnson's seagrass, and designated critical habitat for Johnson's seagrass in accordance with Section 7 of the Endangered Species Act. This analysis is based on project-specific information provided by USACE, the consultant, and NMFS's review of published literature. We conclude that the projects are likely to adversely affect, but are not likely to destroy or adversely modify Johnson's seagrass critical habitat. The Opinion includes conservation recommendations for your consideration.

We look forward to further cooperation with you on other USACE projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Audra Livergood, Consultation Biologist, at (786) 351-2225, or by email at audra.livergood@noaa.gov.

Sincerely,

For Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: Biological Opinion

File: 1514-22.F.4
Endangered Species Act - Section 7 Consultation

Biological Opinion

Agency:	United States Army Corps of Engineers (USACE), Jacksonville District
Activity:	Proposed USACE issuance of 3 regulatory permits in Miami-Dade County, Florida (SAJ-2013-00169, SAJ-2013-02641, and SAJ-2015-00622)
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida
	SER-2016-17794 SER-2016-17893 SER-2016-17903
Approved By:	For Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued	5/3/17

Table of Contents

Glossary of Commonly Used Acronyms

ESA	Endangered Species Act
NMFS	National Marine Fisheries Service
USACE	U.S. Army Corps of Engineers

List of Tables

Units of Measurement

Length and Area

ac	acres
ft	foot/feet
ft^2	square feet
lin ft	linear feet

Background
Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species; Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. NMFS and the U.S. Fish and Wildlife Service share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation concludes after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a Biological Opinion ("Opinion") that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat.

This document represents NMFS's Opinion based on our review of impacts associated with the proposed actions to issue a permit for in-water construction activities. This Opinion analyzes the projects' effects to listed species and critical habitat, in accordance with Section 7 of the ESA and is based on project information provided by USACE and other sources of information including the published literature cited herein.

1 CONSULTATION HISTORY

Mr. Robert Diener: NMFS received a request from the USACE on February 25, 2016, and we initiated consultation.

Upper Eastside Miami, LLC: NMFS received a request from the USACE on April 11, 2016, and we initiated consultation.

158 Palm, LLC: NMFS received a request from the USACE on April 14, 2016, and we initiated consultation.

The USACE's and NMFS's determinations on the projects' effects to listed species and critical habitat that the USACE or NMFS believes may be affected by the proposed actions are listed in Table 1 below.

2 DESCRIPTION OF THE PROPOSED ACTIONS AND ACTION AREAS

2.1 Proposed Actions

Mr. Robert Diener: The site consists of a seawall, a 303-ft^2 dock, a 413-ft^2 dock, a boatlift, and a jet ski lift. The applicant proposes to remove the existing 413-ft^2 wooden dock and build a new 413 ft^2 concrete-frame dock with a grated inlay in the same footprint as the existing 413-ft^2 wooden dock. The new dock would be supported by 22, 12-in x 12-in concrete piles. In addition, the applicant proposes to install a 30,000-pound capacity boatlift supported by 4 new

12-in x 12-in concrete piles, a personal watercraft lift supported by 2 new concrete piles, and 3 new wood fender piles. All wood piles are 12-in-diameter and would be installed by impact hammer (no more than 6 piles would be installed per day).

The applicant proposes to remove the existing structures using a barge-mounted crane and workers on land disassembling the docks/lifts. Then, the new dock piles and boatlift piles will be installed using a barge-mounted impact hammer. The site currently supports 3 vessel slips, and no new slips will be added.

Therefore, we will assume that there will be no new shading from the dock replaced of the same size in the same footprint or from vessels since no new slips are proposed. The addition of 9 new 12-in piles associated with boatlifts and fender piles not located under the replacement dock will result in 7.11 ft^2 of impacts.[1]

Image of Diener property with existing 413-ft^2 dock and 2 vessels moored adjacent to it.

A seagrass survey was conducted on April 6, 2015. The report states paddle grass was documented at the site (approximately 5% coverage) along with other resources including barnacles and sponges. No Johnson's seagrass, corals, or mangroves were observed on-site. In-water work will take approximately 6 weeks to complete and will be conducted during daylight hours only. Turbidity curtains will be used during construction. Additionally, the applicant will comply with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* (revised March 23, 2006), which requires work to stop if sea turtles or sawfish are observed within 50 ft of operating or moving construction equipment.

[1] The area of each pile is approximately 0.79 ft^2, Area = $\prod r^2$ where $\prod$=3.1412 and r = 0.5 ft. Therefore, we multiplied 0.79 ft^2 by the number of piles (9), which equals 7.11 ft^2.

Upper Eastside Marina, LLC: The site consists of a seawall, and the substrate is described in the Section 7 checklist as "mud bottom." The applicant proposes to construct a 2,027-ft^2 12-slip marina[2] with 88 new12-in-diameter wood piles supporting the structures and 19 new 12-in-diameter wood mooring piles (for a total of 107 piles). Piles will be driven with an impact hammer via a barge-mounted crane (no more than 6 piles will be driven per day). The site previously provided 12 vessel slips, which is presumably why the section 7 checklist indicates that the proposed project is replacing those slips; however, based on a review of historical images on Google Earth, there appears to be 2 derelict piers at the site dating back to 2006. The piers are still visible in the images until 2014. By January 2016, the piers are no longer visible in the historical images. Because there are no docking facilities at the existing site, our position is that 12 vessel slips will be added, rather than merely replaced by the proposed project.

Therefore, we expect the new structure will shade 2,027 ft^2 and the additional 19 new 12-in mooring piles will impact an additional 15.01 ft^2 (calculating the area of a round pile as explained in the footnote for Project 1). For this project only, the plans indicate the dock structure is framed partly on the inside of the piles and partly on the outside of the piles. It appears approximately 50% of each pile falls outside of the framing for the dock. We will address this additional impact in Section 5. Since the USACE does not know the size of the vessels that will be stored at the site, we estimate the average vessel will be 176 ft^2 (based on the average vessel size in Florida used in the Florida Statewide Programmatic (SER-2013-12540) multiplied by 12 new vessels resulting in an estimated additional shading of 2,112 ft^2.

A seagrass survey was conducted on October 16, 2013. The report states that no Johnson's seagrass is present; however, paddle grass, shoal grass, and manatee grass were documented at the site (approximately 5-30% cover). No corals or mangroves were observed. In-water work will take approximately 30 days and will be conducted during daylight hours only. Turbidity curtains will be required, and the applicant will comply with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions.*

158 Palm, LLC: The site consists of a seawall with riprap along the seawall base extending about 10 ft from the seawall. The applicant proposes to construct a 400-ft^2 dock (20' x 4' walkway and a 40' x 8' terminal platform)[3] with a concrete frame and wood decking supported by 16 new12-in x 12-in concrete piles and 8 new 12-in-diameter wooden fender piles (for a total of 24 piles). All piles will be installed via impact hammer. Two new vessel slips are proposed (measuring 200 ft^2 and 680 ft^2, for a total of 880 ft^2 of shading expected from these vessels).

Therefore, we expect the new dock will shade 400 ft^2, new vessels will shade 880 ft^2, and the 8 new fender piles will impact an additional 6.32 ft^2 (calculating the area of a round pile as explained in the footnote for Project 1).

---

[2] The incoming materials for the consultation are slightly inconsistent. The section 7 checklist submitted for the project indicates "2057 square of dock[,]" but based on the dimensions specified in the section7 request letter from the Corps, the new dock is 2,027 ft^2, (10x20)+(6x210)+(3x27x7) = (200)+(1260)+(567) = 2027. We assume that the 2057 is an error and analyze the effects of a 2,027 ft^2 dock.

[3] The incoming materials are slightly inconsistent. The request letter and checklist indicate a 20'x4' (80'^{2}) walkway with a 40'x8' (320'^{2}) terminal platform. Those dimensions would equate to 400 ft^2, not 380 ft^2; however, the drawing indicates 380'^{2} of dock, still 40'x8' platform with a 15'x4' walkway, about half of which is over existing rip rap. We assume that the 380 ft^2 is an error and analyze the effects of a 400 ft^2 dock.

A seagrass survey was conducted on February 23, 2015. The report states that no Johnson's seagrass is present; however, sponges and paddle grass were documented at the site (approximately 5% cover of paddle grass). No mangroves or corals were observed at the site. In-water work is expected to take approximately 3 weeks and will be conducted during daylight hours only. Turbidity curtains will be required, and the applicant will comply with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions.*

2.2 Action Areas

50 CFR 404.02 defines action area as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The action areas for this project include the waters and submerged lands within, and in the immediate vicinity of, the project site. For the purposes of this Opinion, the "immediate vicinity" includes the behavioral response zone in which animals may be affected by pile-driving activities. All 3 projects propose pile installation via an impact hammer. This method of installation has a behavioral response zone of 705 ft from the pile-driving activities.

All 3 projects are located in Miami-Dade County, Florida, and within Biscayne Bay, an open-water environment (Figure 1) and Johnson's seagrass critical habitat (Northern Biscayne Bay, Unit J).

- The Diener project site is located at 25.880319°N, 80.142057°W (North American Datum 1983 [NAD 83]) at 8 Indian Creek Island Road, Miami.
- The Upper Eastside Miami, LLC project site is located at 25.848632°N, 80.172498°W (NAD 83) at 7965 N.E. Bayshore Court, Miami.
- The 158 Palm, LLC project site is located at 25.779107°N, 80.163066°W (NAD 83) at 158 Palm Avenue, Miami Beach.

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

We believe the species listed in Table 1 may be present within the action areas.

Table 1. Effects Determinations and Status for Species and Critical Habitat in or Near the Action Areas that Either the Action Agency or NMFS Believes May Be Affected by the Proposed Actions

Species	ESA Listing Status	Action Agency Effect Determinations	NMFS Effect Determinations
Sea Turtles			
Green (North and South Atlantic distinct population segment [DPS])	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic Ocean DPSs)	T	NLAA	NLAA

Species	ESA Listing Status	Action Agency Effect Determinations	NMFS Effect Determinations
Hawksbill	E	NLAA	NLAA
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Critical Habitat			
Johnson's seagrass Unit J (all 3 projects)		NLAA (Diener) "May Affect" (Upper Eastside) NE (158 Palm)	LAA; no DAM (all 3 projects)
E = endangered; T = threatened; NE = no effect; NLAA = may affect, not likely to adversely affect; LAA = likely to adversely affect; DAM = destruction or adverse modification			

We would not expect leatherback sea turtles to be present at the site due to their very specific life history requirements which are not supported at or near the project site. Leatherback sea turtles prefer open, deepwater habitat where they forage primarily on jellyfish.

3.1 Species Not Likely to be Adversely Affected

We believe that sea turtles (green, loggerhead, hawksbill, and Kemp's ridley), and smalltooth sawfish may be found in or near the action area and may be affected by the projects covered in this Opinion. We have identified the following potential adverse effects to these species and concluded that they are not likely to be adversely affected by the proposed actions for the reasons described below.

Sea turtles and smalltooth sawfish

3.1.1 Direct Physical Effects

Direct physical injury to sea turtles and smalltooth sawfish is not expected from construction machinery or materials because these species have the ability to detect and move away from the types of construction activities that will be implemented for these projects. The projects will adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, which will provide additional protection by requiring construction equipment to stop if a listed species is observed within 50 ft of operating machinery. Thus, direct physical impacts are considered extremely unlikely to occur and the risk of adverse effects is discountable.

3.1.2 Foraging and Refuge

Sea turtles and smalltooth sawfish may be affected by being temporarily unable to use the site for foraging or refuge due to avoidance of construction activities and physical exclusion from areas blocked by turbidity curtains. Yet we find these effects to be insignificant given their limited impact on foraging and sheltering behavior. The project areas do not contain mangroves, which

are used as refuge habitat by smalltooth sawfish; therefore, the projects will not affect the sheltering behavior of the smalltooth sawfish. Therefore, we believe effects to sea turtles and smalltooth sawfish from temporary exclusion will be insignificant.

Green and hawksbill sea turtles may be affected by the potential permanent loss of foraging habitat caused by the dock installations and vessel mooring activities. Seagrass habitat provides foraging opportunities for adult green sea turtles, and the sponges present at 2 of the project sites provide foraging opportunities for adult hawksbills. The 3 projects combined would shade approximately 5,419 ft^2 of foraging habitat[4] for green and hawksbill sea turtles. NMFS notes that seagrass densities at the project sites were generally low (approximately 5% cover at 2 of the sites and 5-30% cover at one of the sites). Based on these types of project conditions, and that there are undisturbed areas of similar foraging habitat available nearby for green and hawksbill sea turtles, we believe this effect is insignificant.

3.1.3 Risk of Vessel Strike

The 158 Palm Ave. project proposes the addition of 2 vessel slips and the Upper Eastside Miami project proposes the addition of 12 vessel slips (14 slips for the 2 projects combined). The addition of 14 new slips to this area will not necessarily introduce new vessels or increase vessel traffic in the area, as it may relocate existing vessels or provide slips for vessels that were previously trailered or docked elsewhere in the region. Still, even if 14 new vessels are introduced to the area, we conclude, based on a recent NMFS analysis,[5] that potential effects on sea turtles resulting from increased vessel traffic associated with the proposed project are discountable. Smalltooth sawfish is a demersal (i.e., bottom-dwelling) species; therefore, we do not expect there to be an increased risk of vessel strike for smalltooth sawfish.

3.1.4 Pile Driving and Noise Effects

Effects to listed species as a result of noise created by construction activities can be physically injurious to animals in the affected areas, or result in behavioral changes by animals in the affected areas. Injurious effects can occur in 2 ways. First, effects can result from a single noise event's exceeding the threshold for direct physical injury to animals, and these constitute an immediate adverse effect on affected animals. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects, if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse depending on the circumstances in which they occur (i.e., if such effects prevent animals from feeding, resting, or reproducing). Our evaluation of effects to listed species as a result of noise created by construction activities is based on the analysis prepared in support of the Opinion for SAJ-82.[6] The noise analysis in this consultation evaluates effects to smalltooth sawfish and sea turtles (see species list in Table 1).

---

[4] There are no new areas shaded from Diener; Upper Eastside would shade approximately 4,139 ft^2; and 158 Palm would shade approximately 1,280 ft^2 of foraging habitat (for a total of 5,419 ft^2).

[5] Barnette, M. 2013. Threats and Effects Analysis for Protected Resources on Vessel Traffic Associated with Dock and Marina Construction. NMFS Southest Regional Office Protected Resources Division Memorandum. April 18, 2013.

[6] NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-1590), Florida Keys, Monroe County, Florida. June 10, 2014.

Based on our noise calculations, the installation of wood piles by impact hammer (all 3 projects) will not cause single-strike or peak-pressure injury to sea turtles or smalltooth sawfish. The daily cumulative sound exposure level (cSEL) of multiple pile strikes over the course of a day may cause injury to smalltooth sawfish and sea turtles at a radius of up to 30 ft (9 meters). Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an animal suffering physical injury from noise is extremely unlikely to occur. Even in the unlikely event an animal does not vacate the daily cumulative injurious impact zone, the radius of that area is smaller than the 50-ft radius that construction personnel will be visually monitoring for listed species and they will cease construction activities if an animal is sighted per NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*. Thus, we believe the risk of any injurious cSEL effects occurring is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, impact hammer pile installation could also cause behavioral effects at radii of 151 ft (46 m) for sea turtles and 705 ft (215 m) for smalltooth sawfish. Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances. Because there is similar habitat nearby, we believe behavioral effects will be insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since installation will occur only during the day, these species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, we anticipate any effects will be insignificant.

Based on our noise calculations, installation of concrete piles by impact hammer (Diener and 158 Palm) will not cause single-strike or peak-pressure injurious noise effects. The cumulative sound exposure level of multiple pile strikes over the course of a day, however, may cause injury to smalltooth sawfish and sea turtles up to 72 ft (22 m) away from the pile. Due to the mobility of sea turtles and smalltooth sawfish and because the project occurs in open water, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an animal's suffering physical injury from noise is extremely unlikely to occur and is therefore discountable. An animal's movement away from the injurious sound radius is a behavioral response, with the same effects discussed below.

The installation of piles using an impact hammer could also result in behavioral effects at radii 705 ft (215 m) for smalltooth sawfish and 151 ft (46 m) for sea turtles. Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances in this open-water environment. Because there is similar habitat nearby, we believe behavioral effects will be insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since installation will occur only during the day, these species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, we anticipate any behavioral effects will be insignificant.

3.2 Johnson's Seagrass Critical Habitat

The term "critical habitat" is defined in Section 3(5)(A) of the ESA as (i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (1) essential to the conservation of the species and (2) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. "Conservation" is defined in Section 3(3) of the ESA as "…the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which listing under the ESA is no longer necessary."

NMFS designated Johnson's seagrass critical habitat on April 5, 2000 (65 FR 17786; see also, 50 CFR 226.213). The specific areas occupied by Johnson's seagrass and designated by NMFS as critical habitat are those with 1 or more of the following criteria:

1. Locations with populations that have persisted for 10 years
2. Locations with persistent flowering populations
3. Locations at the northern and southern range limits of the species
4. Locations with unique genetic diversity
5. Locations with a documented high abundance of Johnson's seagrass compared to other areas in the species' range

Ten areas (Units) within the range of Johnson's seagrass (approximately 200 km of coastline from Sebastian Inlet to northern Biscayne Bay, Florida) are designated as Johnson's seagrass critical habitat (Table 4). The total range-wide acreage of critical habitat for Johnson's seagrass is roughly 22,574 acre (ac) (NMFS 2002).

Table 2. Designated Critical Habitat Units for Johnson's Seagrass

Unit A	A portion of the Indian River, Florida, north of the Sebastian Inlet Channel
Unit B	A portion of the Indian River, Florida, south of the Sebastian Inlet Channel
Unit C	A portion of the Indian River Lagoon, Florida, in the vicinity of the Fort Pierce Inlet
Unit D	A portion of the Indian River Lagoon, Florida, north of the St. Lucie Inlet
Unit E	A portion of Hobe Sound, Florida, excluding the federally marked navigation channel of the Intracoastal Waterway
Unit F	A portion of the south side of Jupiter Inlet, Florida
Unit G	A portion of Lake Worth, Florida, north of Bingham Island
Unit H	A portion of Lake Worth Lagoon, Florida, located just north of the Boynton Inlet
Unit I	A portion of northeast Lake Wyman, Boca Raton, Florida, excluding the federally marked navigation channel of the Intracoastal Waterway

Unit J	A portion of northern Biscayne Bay, Florida, including all parts of the Biscayne Bay Aquatic Preserve excluding the Oleta River, Miami River, and Little River beyond their mouths, the federally marked navigation channel of the Intracoastal Waterway, and all existing federally authorized navigation channels, basins, and berths at the Port of Miami to the currently documented southernmost range of Johnson's seagrass, Central Key Biscayne

The physical habitat that supports Johnson's seagrass includes both shallow intertidal and deeper subtidal zones. The species thrives either in water that is clear and deep (2-5 m) or in water that is shallow and turbid. In tidal channels, it inhabits coarse sand substrates. The spread of the species into new areas is limited by its reproductive potential. Johnson's seagrass possesses only female flowers; thus vegetative propagation, most likely through asexual branching, appears to be its only means of reproduction and dispersal. If an established community is disturbed, regrowth and reestablishment are extremely unlikely. This species' method of reproduction impedes the ability to increase distribution as establishment of new vegetation requires considerable stability in environmental conditions and protection from human-induced disturbances.

Essential Features of Critical Habitat

NMFS identified 4 habitat features essential for the conservation of Johnson's seagrass: (1) adequate water quality, defined as being free from nutrient over-enrichment by inorganic and organic nitrogen and phosphorous or other inputs that create low oxygen conditions; (2) adequate salinity levels, indicating a lack of very frequent or constant discharges of fresh or low-salinity waters; (3) adequate water transparency, which would allow sunlight necessary for photosynthesis; and (4) stable, unconsolidated sediments that are free from physical disturbance. All 4 essential features must be present in an area for it to function as critical habitat for Johnson's seagrass.

Critical Habitat Unit Impacted by the Proposed Actions

This consultation focuses on activities that occur in Unit J, which encompasses the northern portion of Biscayne Bay from Northeast 163rd Street south to Central Key Biscayne at 25º45´N (Figure 1). This portion of Biscayne Bay is bound by heavy residential and commercial development, though a few areas of mangrove shoreline remain. Dredge and fill projects have resulted in a number of spoil islands and channels too deep for seagrass growth. Biscayne Bay supports diverse biological communities including intertidal wetlands, seagrasses, hard bottom, and open water. Unit J is wholly within the Biscayne Bay Aquatic Preserve.

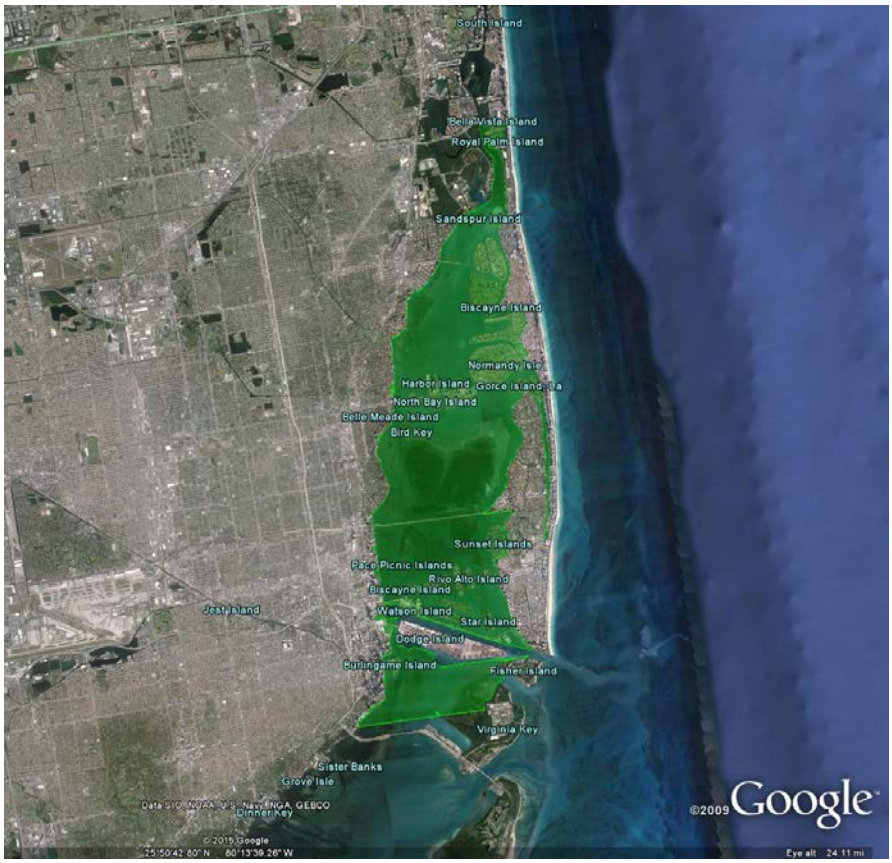

Figure 1. Johnson's seagrass critical habitat Unit J (©2015 Google, Data SIO, NOAA, U.S. Navy, NGA, GEBCO)

Status and Threats

A wide range of activities, many funded authorized or carried out by federal agencies, have and will continue to affect the essential habitat requirements of Johnson's seagrass. These are generally the same activities that may affect the species itself, and include: (1) vessel traffic and the resulting propeller dredging; (2) dredge and fill projects; (3) dock, marina, and bridge construction; (4) water pollution; and (5) land use practices (shoreline development, agriculture, and aquaculture).

Vessel traffic has the potential to affect Johnson's seagrass critical habitat by reducing water transparency. Operation of vessels in shallow water environments often leads to the suspension of sediments due to the spinning of propellers on or close to the bottom. Suspended sediments reduce water transparency and the depth to which sunlight penetrates the water column. Populations of Johnson's seagrass that inhabit shallow water and water close to inlets where vessel traffic is concentrated are likely to be most affected. This effect is expected to worsen with increases in boating activity.

The dredging of bottom sediments to maintain, or in some cases create, inlets, canals, and navigation channels can directly affect essential features of Johnson's seagrass critical habitat. Dredging results in turbidity through the suspension of sediments. As discussed previously, the suspension of sediments reduces water transparency and the depth to which sunlight can penetrate the water column. The suspension of sediments from dredging can also resuspend nutrients, which could result in over-enrichment and/or reduce dissolved oxygen levels. Further,

dredging can destabilize sediments and alter both the shape and depth of the bottom within the dredged footprint. This may affect the ability of the critical habitat to function through the removal or modification of essential features.

Dock, marina, and bridge construction leads to loss of habitat via construction impacts (e.g., pile installation) and shading. Similar to dredging, installation of piles for docks or bridges can result in increased turbidity that can negatively impact water transparency over short durations. Additionally, installed piles also replace the stable, unconsolidated bottom sediments essential for the species. Completed structures can have long-term effects on critical habitat in the surrounding area because of the shade they produce. While shading does not affect water transparency directly, it does affect the amount and/or duration of sunlight that can reach the bottom. The threat posed by dock, marina, and bridge construction is especially apparent in coastal areas where Johnson's seagrass is found.

Other threats include inputs from water pollution and adjacent land use. Johnson's seagrass critical habitat located in proximity to rivers, canal mouths, or other discharge structures is affected by land use within the watershed. Waters with low salinity that are highly colored and often polluted are discharged to the estuarine environment. This can impact salinity, water quality, and water transparency, all essential features of Johnson's seagrass critical habitat. Frequent pulses of freshwater discharge to an estuarine area may decrease salinity of the habitat and provoke physiological stress to the species. Nutrient over-enrichment, caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off, stimulates increased algal growth, decreased water transparency, and diminished oxygen content within the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities. Discharges can also contain colored waters stained by upland vegetation or pollutants. Colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly reducing the amount of shorter wavelength light that reaches the bottom. In general, threats from adjacent land use will be ongoing, randomly occurring events that follow storm events.

4 ENVIRONMENTAL BASELINE

This section is a description of the past and ongoing human and natural factors leading to the current status of the species and its designated critical habitat within the action area. The environmental baseline includes state, tribal, local, and private actions already affecting the species and its critical habitat that will occur contemporaneously with the consultation in progress. Unrelated federal actions affecting Johnson's seagrass and its designated critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are federal and other actions within the action area that may benefit the species or its critical habitat. This Opinion describes these activities in the sections below.

Status of Johnson's Seagrass Critical Habitat within the Action Area

As discussed above, this consultation focuses on an activities occurring in Unit J, which encompasses the northern portion of Biscayne Bay from North East 163rd Street south to Central Key Biscayne at 25º45´N (Figure 3). This portion of Biscayne Bay is bound by heavy residential

and commercial development, though a few areas of mangrove shoreline remain. Dredge-and-fill projects have resulted in a number of spoil islands and channels too deep for seagrass growth. Biscayne Bay supports a diversity of biological communities including intertidal wetlands, seagrasses, hard bottom, assemblages, and open water. Unit J is wholly within the Biscayne Bay Aquatic Preserve.

4.1 Factors Affecting Johnson's Seagrass Critical Habitat in the Action Area

Federal Actions

A wide range of activities funded, authorized, or carried out by federal agencies may affect the essential features of critical habitat for Johnson's seagrass. These include actions permitted or implemented by the USACE such as dredging; dock/marina construction; bridge/highway construction; residential construction; shoreline stabilization; breakwaters; and the installation of subaqueous lines or pipelines. Other federal activities that may affect Johnson's seagrass critical habitat include actions by the Environmental Protection Agency and the USACE to manage freshwater discharges into waterways; management of National Parks; regulation of vessel traffic to minimize propeller dredging and turbidity; and other activities by the U.S. Coast Guard and U.S. Navy. Although these actions have probably affected Johnson's seagrass critical habitat, none of these past actions have destroyed or adversely modified Johnson's seagrass critical habitat.

According to NMFS's Public Consultation Tracking System database, NMFS issued a batched Biological Opinion on October 23, 2014, that included the Diener project site (NMFS tracking # SER-2014-13109). For the Diener site, NMFS estimated a permanent loss of 1,322.78 ft^2 of Johnson's seagrass designated critical habitat due to shading from the dock and vessels as well as loss of the substrate essential feature from the installation of piles.

Private Recreational Vessel Traffic

Marina and dock construction increases recreational vessel traffic within areas of Johnson's seagrass critical habitat, which increases suspended sediments from propellers and could result in propeller dredging. As mentioned above, suspended sediments are known to adversely affect Johnson's seagrass critical habitat by reducing the water transparency essential feature. Shading from dock structures and vessel mooring also affects the water transparency essential feature of the designated critical habitat. Propeller dredging and installation of piles and bridge support structures permanently removes the unconsolidated sediments essential feature of the critical habitat.

Marine Pollution and Environmental Contamination

The projects are located in highly developed coastal areas with extensive canal systems. This can lead to freshwater discharges and nutrient over-enrichment due to coastal runoff and canal discharges into the Bay. Freshwater discharge affects the salinity essential feature of the designated critical habitat while excess nutrients can lead to decreased water transparency and decreased dissolved oxygen content in the water.

State and Federal Activities That May Benefit Johnson's Seagrass Critical Habitat in the Action Area

State and federal conservation measures exist to protect Johnson's seagrass and its habitat under an umbrella of management and conservation programs that address seagrasses in general (Kenworthy et al. 2006). These conservation measures must be continually monitored and assessed to determine if they will ensure the long-term protection of the species and the maintenance of environmental conditions suitable for its continued existence throughout its geographic distribution.

5 EFFECTS OF THE ACTIONS

All 3 projects are located within Johnson's seagrass critical habitat. We believe that 2 of the 4 essential features required for functional Johnson's seagrass critical habitat will not be affected by the projects. The proposed activities will not affect water quality by increasing nutrient enrichment, nor will they affect salinity levels in the project areas.

We believe the proposed activities will adversely affect the adequate water transparency essential feature and the stable, unconsolidated sediments essential feature. The former will be adversely affected by shading from the new docks and the vessels, and the latter will be adversely affected by 162 new piles (combined for all 3 projects). Shading results in the complete loss of the water transparency essential feature of Johnson's seagrass critical habitat, and the loss of one of the essential features results in a total loss in the conservation function of the critical habitat. The area under the piles that support the non-grated dock structures, which would remove the unconsolidated bottom sediment essential feature, is not separately counted toward the total area of impact because impact from the piles, which are underneath the dock, is already included in the area that has been lost due to the shading. There is one exception. For the Upper Eastside project, the plans show the dock structure is framed partly on the inside of the piles and partly on the outside of the piles. It appears approximately 50% of each pile falls outside of the framing for the dock. Therefore, the Upper Eastside project will impact an additional 34.76 ft² of the sediment essential feature[7]. In addition to the impacts from shading and pile installation located beneath each dock, all 3 of the project sites propose additional piles that are not for dock support (e.g., fender piles, mooring piles, boatlift piles), as discussed in Section 2.1.

The following effects to the adequate water transparency essential feature are expected from structures creating shading:

- Mr. Robert Diener: We do not anticipate any new shading from the dock since it will be the same size and replaced in the same footprint and we do not anticipate any new vessel shading because no new slips are proposed. After the removal of the existing dock, shading effects will be removed for a brief period, but shortly thereafter, the new dock will be installed in the same footprint. Therefore, these structures will have no net effect on the adequate water transparency essential feature.

[7] The area of a round pile = .79 ft² x 88 piles divided by 2 = 34.76 ft².

- Upper Eastside Marina, LLC: We believe the project will shade 2,027 ft² from the dock and 2,112 ft² from the vessels resulting in adverse effects to 4,139 ft² of the adequate water transparency essential feature.
- 158 Palm, LLC: We believe the project will shade 400 ft² from the dock and 880 ft² from the vessels resulting in adverse effects to 1,280 ft² of the adequate water transparency essential feature.

The following effects to the stable, unconsolidated sediments that are free from physical disturbance essential feature are expected from the placement of piles not located under shaded structures:

- Mr. Robert Diener: The installation of 9 new 12-inch diameter piles to support the boatlift and fender piles will result in the loss of 7.11 ft² of the stable, unconsolidated sediments essential feature.
- Upper Eastside Marina, LLC: The installation of 19 new 12-inch diameter mooring piles will result in the loss of 15.01 ft² of the stable, unconsolidated sediments essential feature. An additional 34.76 ft² of the sediments essential feature will be lost from the dock piles for this project only (i.e., this is the area of the piles that falls outside of the dock framing).
- 158 Palm, LLC: The installation of 8 new twelve-inch diameter fender piles will result in the loss of 6.32 ft² of the stable, unconsolidated sediments essential feature.

Table 3 provides a summary of the anticipated impacts to Johnson's seagrass critical habitat from the proposed projects' activities, as calculated in Section 2.1 and explained above.

Table 3. Impacts to Johnson's Seagrass Critical Habitat

	Project Name	**Critical habitat impact shade impacts from new docks and vessels (ft²)**	**Critical habitat impacts from new piles that are not for dock support (ft²)**	**Critical habitat impacts from new piles that partially fall outside of the dock footprint (ft²)**	**Total critical habitat impacted (ft²)**
1	Mr. Robert Diener	0	7.11	0	7.11
2	Upper Eastside Marina, LLC	4,139	15.01	34.76 ft²	4,154.01
3	158 Palm, LLC	1,280	6.32	0	1,286.32
	Total	5,419	28.44	0	**5,482.2**

The installation of the piles will have a temporary effect on Johnson's seagrass critical habitat by increasing turbidity (i.e., it will affect water transparency), this effect is expected to be contained to the immediate areas by the placement of turbidity curtains that will remain in place until construction is complete and water transparency has returned to pre-construction conditions.

Combined, we believe the 3 projects will adversely affect 5,447.44 ft² of Johnson's seagrass critical habitat (see Table 3 on previous page).

6 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, or local private actions that are reasonably certain to occur in the action areas considered in this Opinion. Future federal actions that are unrelated to the proposed actions are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

No categories of effects beyond those already described are expected in the action areas. Dock and marina construction will likely continue at current rates, with associated loss and degradation of seagrass habitat, including Johnson's seagrass critical habitat. Because these activities are subject to USACE permitting and thus, the ESA Section 7 consultation requirement, they do not lead to cumulative non-federal effects to be discussed in this section. NMFS and the USACE have developed protocols to encourage the use of light-transmitting materials in future construction of docks constructed in or over submerged aquatic vegetation (SAV), marsh or mangrove habitat, namely the *Construction Guidelines in Florida for Minor Piling-Supported Structures Constructed in or over Submerged Aquatic Vegetation (SAV), Marsh or Mangrove Habitat*, and for docks within the range of Johnson's seagrass, namely NMFS and USACE's *Key for Construction Conditions for Docks or Other Minor Structures Constructed in or over Johnson's Seagrass* (*Halophila johnsonii*). Even if all new docks are constructed in full compliance with the NMFS and USACE's guidance, NMFS acknowledges that shading impacts (and thus, impacts to the water transparency essential feature) to Johnson's seagrass will continue via dock construction. As NMFS and the USACE continue to encourage permit applicants to design and construct new docks in full compliance with the construction guidelines discussed above, and the recommendations in (Adam 2012), Landry et al. (2008), and Shafer et al. (2008), NMFS believes that shading impacts to Johnson's seagrass will be reduced in the short- and long-term. Moreover, even with some shading from grated construction materials, researchers have found all 4 essential features necessary for Johnson's seagrass to persist under docks constructed of grated decking (Landry et al. 2008).

Upland development and associated runoff will continue to degrade the water quality essential feature necessary for Johnson's seagrass critical habitat. Flood control and imprudent water management practices will continue to result in freshwater inputs into estuarine systems, thereby degrading and altering the water quality and salinity essential features of Johnson's seagrass critical habitat.

Increased recreational vessel traffic will continue to result in damage to Johnson's seagrass and its designated critical habitat by improper anchoring, propeller scarring, and accidental groundings. Nonetheless, we expect that ongoing boater education programs and posted signage about the dangers to seagrass habitat from propeller scarring and improper anchoring may reduce impacts to Johnson's seagrass designated critical habitat, including that in Unit J.

7 DESTRUCTION/ADVERSE MODIFICATION ANALYSIS

NMFS's regulations define *destruction or adverse modification* to mean "a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (50 CFR § 402.02). Alterations that may destroy or adversely modify critical habitat may include impacts to the area itself, such as those that would impede access to or use of the essential features. We intend the phrase "significant delay" in development of essential features to encompass a delay that interrupts the likely natural trajectory of the development of physical and biological features in the designated critical habitat to support the species' recovery. NMFS will generally conclude that a Federal action is likely to "destroy or adversely modify" designated critical habitat if the action results in an alteration of the quantity or quality of the essential physical or biological features of designated critical habitat, or that precludes or significantly delays the capacity of that habitat to develop those features over time, and if the effect of the alteration is to appreciably diminish the value of critical habitat for the conservation of the species. This analysis takes into account the geographic and temporal scope of the proposed action, recognizing that "functionality" of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species and progress toward recovery. Destruction or adverse modification does not depend strictly on the size or proportion of the area adversely affected, but rather on the role the action area serves with regard to the function of the overall designation, and how that role is affected by the action.

Recovery for Johnson's seagrass as set forth in the final recovery plan (NMFS 2002), will be achieved when the following recovery objectives are met: (1) the species' present geographic range remains stable for at least 10 years, or increases; (2) self-sustaining populations are present throughout the range at distances less than or equal to the maximum dispersal distance to allow for stable vegetative recruitment and genetic diversity; and (3) populations and supporting habitat in its geographic range have long-term protection (through regulatory action or purchase acquisition). We evaluated the projects' expected impacts on critical habitat to determine whether it will be able to continue to provide its intended functions in achieving these recovery objectives and supporting the conservation of the species.

The first recovery criterion for Johnson's seagrass is for its present range to remain stable for 10 years or to increase during that time. NMFS's 5-year review (2007) of the status of the species concluded that the first recovery objective had been achieved as of 2007. In fact, the range had increased slightly northward at that time and we have no information indicating range stability has decreased since then. NMFS has determined that the three projects will adversely affect a total of 5,482.2 ft^2 of Johnson's seagrass critical habitat due to shading and pile installation. But the action areas are not at a boundary of the species' range, the areas that will be impacted are very small, and the loss of these potential areas for colonization will not affect the stability of the species' range now or in the future. Thus, we believe the proposed actions' effects will not impact the critical habitat's ability to contribute to range stability for Johnson's seagrass.

The second recovery criterion for Johnson's seagrass requires that self-sustaining populations be present throughout the range at distances less than or equal to the maximum dispersal distance for the species. Due to its asexual reproductive mode, self-sustaining populations are present throughout the range of species. As discussed in Section 3.2, there are approximately 22,574 ac of Johnson's seagrass critical habitat. The loss of 5,482.2 ft² (0.13 ac) of designated critical habitat for Johnson's seagrass would equate to a loss of 0.0006% of Johnson's seagrass critical habitat (0.13 ac x 100 /22,574 ac). The loss of 5,482.2 ft² (0.13 ac) of designated critical habitat for Johnson's seagrass in Unit J specifically would equate to a loss of 0.0007% of Johnson's seagrass critical habitat (0.13 ac x 100 /18,757 ac in Unit J). The loss of 0.0007% of Johnson's seagrass critical habitat (or 0.0007% within Unit J specifically), will not significantly reduce the available effect of the critical habitat in a way that will significantly impact Johnson's seagrass self-sustaining populations (by adversely affecting the availability of suitable habitat in which the species can spread/flow in the future). Drifting fragments of Johnson's seagrass can remain viable in the water column for 4-8 days (Hall et al. 2006), and can travel several kilometers under the influence of wind, tides, and waves. Because of this, we believe that the removal of 5,482.2 ft^2 of critical habitat for these projects will not appreciably diminish the conservation value of critical habitat in supporting self-sustaining populations.

The final recovery criterion is for populations and supporting habitat in the geographic range of Johnson's seagrass to have long-term protection (through regulatory action or purchase acquisition). Though the affected portions of the project sites will not be available for the long-term, thousands of acres of designated critical habitat are still available for long-term protection, which would include areas surrounding the action areas.

Therefore, we conclude that the proposed actions' adverse effects on Johnson's seagrass critical habitat will not impede achieving the recovery objectives listed above and will, therefore, not appreciably diminish the value of critical habitat for the conservation of the species.

8 CONCLUSION

We have analyzed the best available data, the current status of the species and the critical habitat, environmental baseline, effects of the proposed actions, and cumulative effects to determine whether the proposed actions are likely to destroy or adversely modify Johnson's seagrass critical habitat. It is our Opinion that the proposed actions are likely to adversely affect, but are not likely to destroy or adversely modify Johnson's seagrass critical habitat.

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NMFS believes the following conservation recommendations are reasonable, necessary, and appropriate to conserve and recover Johnson's seagrass. NMFS strongly recommends that these measures be considered and adopted.

1. NMFS recommends that the USACE, in coordination with seagrass researchers and industry, support ongoing research on light requirements and transplanting techniques to preserve and restore Johnson's seagrass, and on collection of plants for genetics research, tissue culture, and tissue banking.

2. NMFS recommends that the USACE continue promoting the use of the October 2002 *Key for Construction Conditions for Docks or other Minor Structures Constructed in or over Johnson's Seagrass* as the standard construction methodology for proposed docks located in the range of Johnson's seagrass.

3. NMFS recommends that the USACE review and implement the recommendations in the July 2008 report, *The Effects of Docks on Seagrasses, With Particular Emphasis on the Threatened Seagrass, Halophila johnsonii* (Landry et al. 2008).

4. NMFS recommends that the USACE review and implement the Conclusions and Recommendations in the October 2008 report, *Evaluation of Regulatory Guidelines to Minimize Impacts to Seagrasses from Single-family Residential Dock Structures in Florida and Puerto Rico* (Shafer et al. 2008).

5. NMFS recommends that a report of all current and proposed USACE projects in the range of Johnson's seagrass be prepared and used by the USACE to assess impacts on the species from these projects, to assess cumulative impacts, and to assist in early consultation that will avoid and/or minimize impacts to Johnson's seagrass and its critical habitat. Information in this report should include location and scope of each project and identify the federal lead agency for each project. The information should be made available to NMFS.

6. NMFS recommends that the USACE conduct and support research to assess trends in the distribution and abundance of Johnson's seagrass. Data collected should be contributed to the Florida Fish and Wildlife Conservation Commission's Florida Wildlife Research Institute to support ongoing geographic information system mapping of Johnson's seagrass and other seagrass distribution.

7. NMFS recommends that the USACE prepare an assessment of the effects of other actions under its purview on Johnson's seagrass for consideration in future consultations.

10 REINITIATION OF CONSULTATION

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) the amount or extent of taking specified in the proposed action is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the identified action is

subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Biological Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

11 LITERATURE CITED

Dawes, C.J., Lobban, C.S., Tomasko, D.A., 1989. A comparison of the physiological ecology of the seagrasses *Halophila decipiens* Ostenfeld and *H. johnsonii* Eiseman from Florida. Aquatic Botany 33, 149-154.

DiCarlo, G., Badalamenti, F., Jensen, A.C., Koch, E.W., Riggio, S. 2005. Colonization process of vegetative fragments of *Posidonia oceanica* (L.) Delile on rubble mounds. Marine Biology 147, 1261-1270.

Durako, M.J., Kunzelman, J.I., Kenworthy, W.J., Hammerstrom, K.K., 2003. Depth-related variability in the photobiology of two populations of *Halophila johnsonii* and *Halophila decipiens.* Marine Biology 142, 1219-1228.

Eiseman, N. and C. McMillan. 1980. A new species of seagrass, Halophila johnsonii, from the Atlantic coast of Florida. Aquatic Botany 9: 15-19.

Fonseca, M. S., W. Kenworthy, and P. E. Whitfield. 2000. Temporal dynamics of seagrass landscapes: a preliminary comparison of chronic and extreme disturbance events. Proceedings of the Fourth International Seagrass Biology Workshop. Biología Marina Mediterranea 7:373-376.

Gallegos, C.L., Kenworthy, W.J., 1996. Seagrass depth limits in the Indian River Lagoon (Florida, USA): Application of the optical water quality model. Estuarine, Coastal, and Shelf Science 42, 267-288.

Hall, L. M., M. D. Hanisak, and R. W. Virnstein. 2006. Fragments of the seagrasses *Halodule wrightii* and *Halophila johnsonii* as potential recruits in Indian River Lagoon, Florida. Marine Ecology Progress Series 310:109-117.

Hammerstrom, K. and W. Judson Kenworthy. 2002. Investigating the existence of a *Halophila johnsonii* sediment seed bank. Center for Coastal Fisheries and Habitat Research. NCCOS, NOS, NOAA, Beaufort, North Carolina.

Heidelbaugh, W.S., Hall, L.M., Kenworthy, W.J., Whitfield, P.E., Virnstein, R.W., Morris, L.J., Hanisak, M.D. 2000. Reciprocal transplanting of the threatened seagrass *Halophila johnsonii* (Johnson's seagrass) in the Indian River Lagoon, Florida. In: Bortone, S.A. (Eds.), Seagrasses: Monitoring, Ecology, Physiology, and Management. CRC Press. Boca Raton, FL, 197-210.

Jewett-Smith, J., C. McMillan, W.J. Kenworthy, and K. Bird. 1997. Flowering and genetic banding patterns of *Halophila johnsonii* and conspecifics. Aquatic Botany 59 (1997) 323-331.

Kenworthy, W.J. and D.E. Haunert. 1991. The light requirements of seagrasses: proceedings of a workshop to examine the capability of water quality criteria, standards, and monitoring programs to protect seagrasses. NOAA Technical Memorandum NMFS-SEFC-287.

Kenworthy, W.J. 1993. The distribution, abundance and ecology of *Halophila johnsonii* (Eiseman) in the lower Indian River, Florida. Final Report to NMFS Office of Protected Resources. 72 pp.

Kenworthy, W.J. 1997. An updated biological status review and summary of the Proceedings of a Workshop to Review the Biological Status of the Seagrass, *Halophila johnsonii* (Eiseman). Report submitted to NMFS Office of Protected Resources, October 15, 1997. 24 pp.

Kenworthy, W.J. 1999. Demography, population dynamics, and genetic variability of natural and transplanted populations of *Halophila johnsonii*, a threatened seagrass. Annual Progress Report, July 1999.

Kenworthy, W.J., 2000. The role of sexual reproduction in maintaining populations of *Halophila decipiens*: implications for the biodiversity and conservation of tropical seagrass ecosystems. Pacific Conservation Biology 5, 260-268.

Kenworthy, W.J., Wyllie-Echeverria, S., Coles, R.G., Pergent, G., Pergent-Martini, C., 2006. Seagrass Conservation Biology: An Interdisciplinary Science for Protection of the Seagrass Biome. In: Larkum, A.W.D., Orth, R.J., Duarte, C.M., (Eds.), Seagrasses: Biology, Ecology, and Conservation. Springer. Dordrecht, The Netherlands, 595-623.

Kunzelman, J.I. 2007. Southern Range, permanent transect implementation, summer sampling 2006. Report prepared for the Johnson's Seagrass Recovery Team. Florida Fish and Wildlife Conservation Commission, St. Petersburg, Florida. 23 pp.

Landry, J. B., W. J. Kenworthy, and G. D. Carlo. 2008. The effects of docks on seagrasses, with particular emphasis on the threatened seagrass, *Halophila johnsonii*. Report submitted to NMFS Office of Protected Resources.

NMFS. 2002. Recovery plan for Johnson's seagrass (*Halophila johnsonii*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.

National Marine Fisheries Service. 2007. Endangered Species Act 5-Year Review Johnson's Seagrass (*Halophila johnsonii Eiseman*). Prepared by NOAA's Johnson's Seagrass Status Review Team, Silver Spring, Maryland. 58 pp.

Oppenheimer, C. H. 1963. Effects of Hurricane Carla on the Ecology of Redfish Bay, Texas. Bulletin of Marine Science 13(1):59-72.

Philbrick, C. T., Les, D.H., 1996. Evolution of aquatic angiosperm reproductive systems. BioScience 46, 813-826.

Shafer, D. J., J. Karazsia, L. Carrubba, and C. Martin. 2008. Evaluation of regulatory guidelines to minimize impacts to seagrasses from single-family residential dock structures in Florida and Puerto Rico. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Steward, J., R. Virnstein, M. Lasi, L. Morris, J. Miller, L. Hall, and W. Tweedale. 2006. The impacts of the 2004 hurricanes on hydrology, water quality, and seagrass in the Central Indian River Lagoon, Florida. Estuaries and Coasts 29(6):954-965.

van Tussenbroek, B. I. 1994. The Impact of Hurricane Gilbert on the Vegetative Development of *Thalassia testudinum* in Puerto Morelos Coral Reef Lagoon, Mexico: A Retrospective Study. Pages 421 *in* Botanica Marina.

Virnstein, R.W., L.J. Morris, J.D. Miller, and R. Miller-Myers. 1997. Distribution and abundance of *Halophila johnsonii* in the Indian River Lagoon. St. Johns River Water Management District Tech Memo #24. November 1997. 14 pp.

Virnstein, R. W., and L. J. Morris. 2007. Distribution and abundance of Halophila johnsonii in the Indian River Lagoon: An update. Technical Memorandum # 51. St. Johns River Water Management District, Palatka, Florida.

Virnstein, R.W., and Hall, L.M., 2009. Northern range extension of the seagrasses *Halophila johnsonii* and *Halophila decipiens* along the east coast of Florida, USA. Aquatic Botany 90, 89-92.

Virnstein, R.W., L.C. Hayek, and L.J.Morris. 2009. Pulsating Patches: a model for the spatial and temporal dynamics of the threatened seagrass Halophila johnsonii. Marine Ecology Progress Series, 385: 97-109.

Whitfield, P. E., W. J. Kenworthy, K. K. Hammerstrom, and M. S. Fonseca. 2002. The Role of a Hurricane in the Expansion of Disturbances Initiated by Motor Vessels on Seagrass Banks. Journal of Coastal Research (ArticleType: research-article / Issue Title: SPECIAL ISSUE NO. 37. IMPACTS OF MOTORIZED WATERCRAFT ON SHALLOW ESTUARINE AND COASTAL MARINE ENVIRONMENTS / Full publication date: FALL 2002 / Copyright © 2002 Coastal Education & Research Foundation, Inc):86-99.