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

OCT 04 2017

F/SER46: DR

Ann Broadwell
Environmental Administrator
Florida Department of Transportation District 4
3400 West Commercial Boulevard
Fort Lauderdale, Florida 33309

Dear Ms. Broadwell:

Enclosed is the National Marine Fisheries Service's (NMFS) Biological Opinion (Opinion) on the Florida Department of Transportation's (FDOT) proposed action. The Florida Department of Transportation has received National Environmental Policy Act assignment authority from the Federal Highway Administration and is acting as their representative for this Endangered Species Act (ESA) Section 7 consultation.

Applicant(s)	SER Number	Project Type(s)
Florida Department of Transportation District 4	SER-2017-18536	Bridge replacement (construction and demolition)

This Opinion analyzes project effects on sea turtles (loggerhead, leatherback, Kemp's ridley, hawksbill, and green), smalltooth sawfish, and Johnson's seagrass, in accordance with Section 7 of the Endangered Species Act. This analysis is based on project-specific information provided by FDOT, the consultant, and NMFS's review of published literature. We conclude that this project is likely to adversely affect, but is not likely to jeopardize the continued existence of Johnson's seagrass. Because the section 7 requirement to prepare an incidental take statement (ITS) does not apply to listed plants, no ITS is provided for this action. However, we have included conservation recommendations for your consideration.

We look forward to further cooperation with you on other FDOT projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Dr. Dave Rydene, Consultation Biologist, at (727) 824-5379, or by email at David.Rydene@noaa.gov.

Sincerely,

F.r
Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: Biological Opinion
NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006
File: 1514-22.L.4

Endangered Species Act - Section 7 Consultation -Biological Opinion

Agency:	Florida Department of Transportation District 4 (FDOT)
Activity:	Replacement of the State Road (S.R.) A1A North Causeway Bridge
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida NMFS Consultation Number SER-2017-18536
Approved By:	For Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued	10/4/2017

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Glossary of Commonly Used Acronyms

cSEL	Cumulative Sound Exposure Level
dB	Decibels
DPS	Distinct Population Segment
ESA	Endangered Species Act
FDOT	Florida Department of Transportation
FRP	Fiberglass-reinforced Polymer
FY	Fiscal Year
ITS	Incidental Take Statement
LAA	Likely To Adversely Affect
NE	No Effect
NLAA	Not Likely To Adversely Affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic And Atmospheric Administration
PRD	Protected Resources Division
RMS	Root Mean Square
SFWMD	South Florida Water Management District
SJRWMD	St. John's River Water Management District
SPGP	State Programmatic General Permit
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

Units of Measurement

Temperature

°C	degrees Celsius

Length and Area

ac	acre
in	inch(es)
ft	foot/feet
km	kilometer(s)
ft^2	square foot/feet
m	meter(s)
psu	practical salinity units

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 shall insure 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. NMFS and the U.S. Fish and Wildlife Service (USFWS) 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 action to issue a permit for in-water construction activities. This Opinion analyzes the project's effects to listed species and critical habitat, in accordance with Section 7 of the ESA, and is based on project information provided by FDOT, the consultant, and other sources of information including the published literature cited herein.

1 CONSULTATION HISTORY

On March 23, 2017, NMFS received a request by email for ESA consultation from the FDOT. FDOT also sent a Natural Resource Assessment that included an Endangered Species Biological Assessment. NMFS requested additional information via email on March 27, 2017, and we received a response on March 28, 2017. NMFS made another information request on March 31, 2017. We received a response on April 28, 2017, and we initiated the consultation on that date. Additional information was received on August 1, 2017 and August 16, 2017.

Project Location

Address	Latitude/Longitude	Water body
S.R. A1A North Causeway Bridge	27.471527ºN, 80.325718ºW (North American Datum 1983)	Indian River Lagoon, Florida

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Project Description

The applicant proposes the replacement of the existing 2-lane bascule (drawbridge) S.R. A1A North Causeway Bridge that spans the Indian River Lagoon (Florida) with a new 2-lane, high-level, fixed-span bridge. The vertical clearance at the navigation channel will be 86 feet (ft) with a horizontal clearance of at least 125 ft in the navigation channel. Length of the new bridge will be approximately 2,050 ft. The project is expected to take about to 3 years to complete.

The Indian River Lagoon is an estuarine waterbody. The project lies 3.03 miles from the Fort Pierce Inlet that leads to the Atlantic Ocean. The width of the waterway at the S.R. A1A North Causeway Bridge location is about 1,970 (ft). Water depths at the project site range from 0 at the shoreline to about -13 ft or more. Average depths in the project area are -4 to -5 ft. The bottom is mostly composed of sand mixed with some shell hash. Seagrasses within the project area include Johnson's seagrass, paddle grass, manatee grass, turtle grass, and shoal grass. Red, black, and white mangroves also occur in the project area.

Demolition of the existing bridge will be accomplished by mechanical means. The superstructure will be cut into pieces and loaded onto barges by crane, then the piles will be cut off below the mudline or pulled out by crane and loaded onto barges. The material will be disposed of at an appropriate upland site and likely later used at permitted offshore artificial reef sites. Placement of materials at artificial reefs will require separate Section 7 consultation with NMFS. No explosive demolition is proposed.

Construction and demolition activities will require the installation of 2 temporary work trestles. Both trestles will be 40 ft wide. One trestle will extend 400-500 ft into the water from the west causeway and the other will extend 200 ft into the water from the east causeway. Construction of the work trestles will require the impact hammer installation of 51 steel pipe piles, each with a diameter of 24 inches (in). It should take approximately 2,500 hammer strikes to install a single pile and only 1 pile will be installed in a single day with 1-2 days of set up between pipe pile installations. When the trestles are no longer needed the pipe piles will be removed by crane, possibly in association with a vibratory hammer.

Bridge construction will require the installation of concrete piles for the bridge substructure. All concrete piles will be installed using an impact hammer. The bridge will require a total of approximately 350 solid square concrete piles (30-in by 30-in). A maximum of 3,400 hammer strikes will be required to install each pile and 4-6 piles will be driven per day. This means the maximum number of hammer strikes per day would be 20,400 strikes per day (6 piles per day x 3,400 strikes per pile = 20,400 strikes per day total).

Based on past bridge projects, it is expected that heavy equipment such as cranes, dump trucks, backhoes, and graders would also be used during construction. Where water depths allow, in-water work will be accomplished from barges to support cranes and pile-driving equipment. Small work boats will also be used during bridge construction. As the barges will be operating in deeper waters where seagrasses do not occur, no seagrass impacts are expected due to barge operation or spudding.

The bridge's navigation channel fender system will require the installation of 104 fiberglass-reinforced polymer (FRP) piles (diameter of 14 in). Up to 10 FRP piles will be installed per day with a combination of jetting and vibratory hammering. Based on previous similar bridge projects, a maximum of 8 hours of vibratory hammering per day is assumed for the purposes of this consultation's in-water noise analysis, although actual daily vibratory hammer use will likely be less than 8 hours. The fender piles will be installed before the bridge piles are installed.

Approximately 256 ft of the bridge navigation channel's length will be dredged 20 ft wider on either side of the existing channel (about 10,240 ft^2 or 3,000 yds^3 of sand/shell hash bottom). This is expected to be accomplished by clamshell dredge or dragline mounted on a barge. If a different method, such as hopper dredging, is selected to accomplish the channel widening, then NMFS must be contacted to determine if reinitiation of this Section 7 consultation is needed. The resulting spoil will be disposed of at an appropriate upland location.

In-water impact pile driving will only occur during daylight hours. A "ramp-up" method will be used to initiate impact driving of piles each day. The "ramp-up" method involves slowly increasing the power of the impact hammer, and the noise it produces, over a 5-10 minute period to give ESA-listed animals an opportunity to leave the work area as noise levels increase. The "ramp-up" technique must be reinitiated if impact driving stops for a period of greater than 1 hour. "Ramp-up" is not required for vibratory driving. FDOT has committed to the use of bubble curtains during impact pile driving to avoid and/or minimize noise effects to protected species. The applicant has agreed to adhere to the NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 26, 2006. This includes ceasing operations if a listed species is spotted within 50 ft of in-water construction activities. A seagrass protection plan will be developed and seagrass beds in the project area will be delineated with buoys to avoid accidental damage. The contractor will implement Best Management Practices to control erosion and sedimentation from upland portions of the project to surface waters in accordance with FDOT's Standard Specifications for Road and Bridge Construction. Turbidity curtains will surround all in-water construction activities and will not be removed until turbidity levels have returned to ambient conditions. The contractor will prevent construction debris from bridge construction and demolition activities from accumulating within the Indian River Lagoon and ensure bottom elevation remains unchanged to the extent practicable. Although the project is not in Johnson's seagrass designated critical habitat, it is expected that the project will directly impact approximately 0.02 acre (ac) of Johnson's seagrass and indirectly impact 0.02 ac of Johnson's seagrass. It is also expected that 0.26 ac of non-listed seagrasses will be directly impacted and 0.10 ac of non-listed seagrasses will be indirectly impacted. Approximately 0.27 ac of mangroves will be directly impacted and 1.07 ac will be indirectly impacted. It is estimated that about 75% of these are red mangroves. However, they are located at the toe of the slope of the existing road, on exposed flats, or growing within riprap. Because of their location these mangroves would only be inundated during intermittent high water events such as storms, and would not accessible to listed species the majority of the time.

2.2 Action Area

The project is located at 27.471527ºN, 80.325718ºW North American Datum 1983, in the Intracoastal Waterway, Fort Pierce, St. Lucie County, Florida (Figure 1). 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 area for this project includes the waters and submerged lands within and in the immediate vicinity of the project site and within a radius where endangered species could be exposed to potentially harmful noise levels which includes a 2,814 ft radius as calculated in Section 3.1.3.

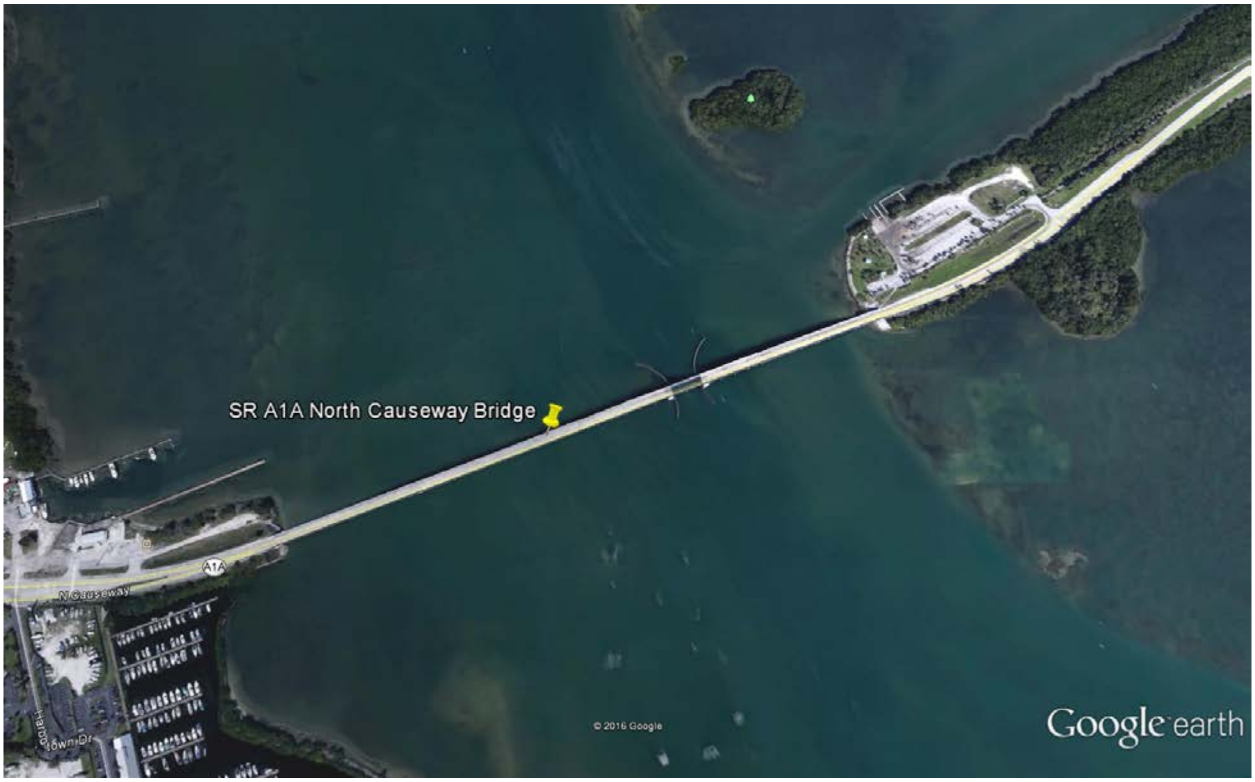

Figure 1. S.R. A1A Bridge location and surrounding area (©2016 Google).

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

We believe the species listed in Table 1 may be present in the action area. The project is not located in designated critical habitat, and there are no potential routes of effect to any designated critical habitat.

Table 1. Effects Determinations for Species that May Be Present in the Action Area

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North and South Atlantic distinct population segments [DPS])	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic Ocean DPS)	T	NLAA	NLAA
Hawksbill	E	NLAA	NE
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Invertebrates and Marine Plants			
Johnson's seagrass	T	LAA	LAA

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; NE = no effect			

The FDOT determined that hawksbill and leatherback sea turtles may be affected by the proposed action; however, we believe the project will have no effect on hawksbill or leatherback sea turtles, due to the species' very specific life history strategies, which are not supported at the project site. Leatherback sea turtles have a pelagic, deepwater life history, where they forage primarily on jellyfish. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges.

3.1 Species Not Likely to be Adversely Affected

Three sea turtles (Kemp's ridley, loggerhead, and green) and the smalltooth sawfish may be present in the action area and may be affected by the project. We have concluded that these species are not likely to be adversely affected by the proposed action for the reasons described below.

3.1.1 Direct Physical Effects

Direct physical injury to sea turtles and smalltooth sawfish is not expected from construction machinery (e.g., cranes and pile-driving equipment), work vessels, or materials (e.g., demolition debris) because we expect sea turtles and smalltooth sawfish to detect and move away from the types of construction activities that are proposed for this project. Additionally, required turbidity controls may act as a physical barrier to species presence during construction. The project will adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006 (enclosed), which will provide additional protection by requiring in-water work to stop if a listed species is observed within 50 ft of operating machinery, and work vessels to operate at idle speeds at all times in the project area. Thus, direct physical impacts are considered extremely unlikely to occur and adverse effects are therefore discountable.

Potential effects to ESA-listed species include the risk of interaction with dredging equipment or material during dredging; however, NMFS has previously determined in dredging biological opinions that, while oceangoing hopper-type dredges may lethally entrain protected species, non-hopper type dredging methods (i.e., clamshell dredge or a dragline mounted on a barge) are slower and extremely unlikely to affect these species. Additionally, the applicant's implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* will further reduce the risk by requiring all construction workers to watch for sea turtles and smalltooth sawfish. Operation of any equipment will cease immediately if a protected species is seen within a 50-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition. Therefore, we believe impacts are extremely unlikely to occur, and the risk of interaction with this project's dredging equipment is discountable.

3.1.2 Foraging and Refuge

Sea turtles and smalltooth sawfish may be temporarily unable to use the project site for forage and shelter habitat due to avoidance of construction activities, related noise, and physical exclusion from areas blocked by turbidity curtains. We expect these effects will be temporary and small in nature (turbidity curtains will only be used in the immediate area of the in-water construction activities). Also, because these species are mobile, we expect that they will move away from the construction activities and forage in adjacent areas with similar available habitat. Therefore, the effects to sea turtles and smalltooth sawfish from the temporary loss of foraging and refuge habitat will be insignificant.

The project will directly and indirectly (shading) result in permanent loss of about 0.33 ac of seagrass habitat, used for foraging by green sea turtles. However, there is similar habitat available immediately adjacent to the project site. Given that sea turtles are mobile, we expect them to forage in these adjacent areas. Therefore, effects to green sea turtles due to permanent loss of seagrass foraging habitat will be insignificant.

The project area does contain red mangroves typically used for foraging and sheltering by juvenile smalltooth sawfish. However, these mangroves are located at the toe of the slope of the existing road, on exposed flats, or growing within riprap. Because of their location these mangroves would only be inundated during intermittent high water events such as storms, and would not accessible to juvenile smalltooth sawfish most of the time. Therefore, effects to these species due to the permanent loss of mangrove habitat will be insignificant.

3.1.3 Noise Impacts

Noise created by construction activities (e.g., pile installations) can be physically injurious to, or result in behavioral changes by animals in the affected areas. Physically 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 immediate adverse effects on affected animals. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative sound 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 interfere with animals feeding, resting, or reproducing). All in-water noise levels discussed below are referenced to 1 micropascal. The NMFS-accepted noise thresholds for impact pile driving are 206 decibels (dB) for peak-pressure injury, 187 dB for cumulative sound exposure level (cSEL) injury, 150 dB root mean square (RMS) for behavioral disturbance of fishes, and 160 dB RMS for behavioral disturbance of sea turtles[1]. The NMFS-accepted noise thresholds for vibratory driving are the same as for impact driving with the exception of the cSEL injury threshold, which is 234 dB for vibratory driving.

Based on our noise calculations, the installation of 30-in by 30-in square solid concrete piles by impact hammer, and with the use of bubble curtains for -11 dB of noise reduction, could cause peak-pressure injury to smalltooth sawfish and sea turtles. Peak-pressure sound levels at the source would be 209 dB, while the NMFS-accepted peak-pressure noise injury threshold is 206 dB for sawfish and turtles. Peak-pressure injury could occur if a sawfish or sea turtle was within 5 ft of the pile driving operations. The use of the “ramp-up” technique prior to full-force driving will provide sawfish and turtles ample opportunity to leave the project area as noise levels increase and before the peak-pressure injury threshold is reached. Because we anticipate that

[1] NMFS 2014. Regional General Permit SAJ-82 (SAJ-2007-1590), Florida Keys, Monroe County, Florida.

sawfish and turtles will move away from the project area during the "ramp-up" period, we believe that an animal's suffering physical injury from peak-pressure noise exposure is extremely unlikely to occur. The applicant's compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, will provide an additional measure of protection by causing the installation activities to stop if sea turtles or sawfish are spotted within 50 ft of operations. There are adequate avenues for a sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat nearby. Thus, we believe that the potential for peak-pressure injury effects is extremely unlikely and is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

The maximum cSEL at the source will be approximately 222 dB, while the NMFS-accepted cSEL injury threshold is 187 dB. The cSEL of multiple pile strikes to 30-in by 30-in square solid concrete piles (20,400 strikes per day) over the course of a day may cause injury to sawfish and sea turtles at a radius of up to 92 ft from pile driving, if a smalltooth sawfish or turtle remained within this zone for a full day's pile driving. Due to the mobility of sawfish and turtles, we expect them to move away from noise disturbances. Because we anticipate that sawfish and turtles will move away from the project area during the "ramp-up" period, we believe that an animal's suffering physical injury from cSEL noise exposure is extremely unlikely to occur. The project has adequate avenues for a sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat outside of the cSEL injury zone. Thus, we believe the risk of injury is extremely unlikely and is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

The impact hammer installation of 30-in by 30-in square solid concrete piles could cause behavioral disturbance effects at radii of 92 ft from the source for sea turtles and 292 ft from the source for smalltooth sawfish. The 92-ft radius marks the point at which the RMS noise level drops below the NMFS-accepted RMS behavioral disturbance threshold of 160 dB for sea turtles, and the 292-ft radius marks the point at which the RMS noise level drops below the NMFS-accepted RMS behavioral disturbance threshold of 150 dB for sawfish. If an individual chooses to remain within the behavioral disturbance zone, it could be exposed to behavioral noise effects during pile installation and alter its behavioral pattern. Due to the mobility of sea turtles and sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors. In addition, sawfish and turtles 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.

Based on our noise calculations, the installation of 24-in-diameter steel pipe piles by impact hammer, and with the use of bubble curtains for -11 dB of noise reduction, could cause peak-pressure injury to smalltooth sawfish and sea turtles. Peak-pressure sound levels at the source would be 207 dB, while the NMFS-accepted peak-pressure noise injury threshold is 206 dB for sawfish and turtles. Peak-pressure injury could occur if a sawfish or sea turtle was within 4 ft of the pile driving operations. The use of the "ramp-up" technique prior to full-force driving will provide sawfish and turtles ample opportunity to leave the project area as noise levels increase and before the peak-pressure injury threshold is reached. Because we anticipate that sawfish and turtles will move away from the project area during the "ramp-up" period, we believe that an animal's suffering physical injury from peak-pressure noise exposure is extremely unlikely to occur. The applicant's compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, will provide an additional measure of protection by causing the installation activities to stop if sea turtles or sawfish are spotted within 50 ft of operations. There are adequate avenues for a sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat nearby. Thus, we believe that the potential for peak-pressure injury effects is extremely unlikely and is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

The maximum cSEL at the source will be approximately 215 dB, while the NMFS-accepted cSEL injury threshold is 187 dB. The cSEL of multiple pile strikes to 24-in-diameter steel pipe piles (2,500 strikes per day) over the course of a day may cause injury to sawfish and sea turtles at a radius of up to 241 ft from pile driving, if a smalltooth sawfish or turtle remained within this zone for a full day's pile driving. Due to the mobility of sawfish and turtles, we expect them to move away from noise disturbances. Because we anticipate that sawfish and turtles will move away from the project area during the "ramp-up" period, we believe that an animal's suffering physical injury from cSEL noise exposure is extremely unlikely to occur. The project has adequate avenues for a sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat outside of the cSEL injury zone. Thus, we believe the risk of injury is extremely unlikely and is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

The impact hammer installation of 24-in-diameter steel pipe piles could cause behavioral disturbance effects at radii of 606 ft from the source for sea turtles and 2,814 ft from the source for smalltooth sawfish. The 606-ft radius marks the point at which the RMS noise level drops below the NMFS-accepted RMS behavioral disturbance threshold of 160 dB for sea turtles, and the 2,814-ft radius marks the point at which the RMS noise level drops below the NMFS-accepted RMS behavioral disturbance threshold of 150 dB for sawfish. If an individual chooses to remain within the behavioral disturbance zone, it could be exposed to behavioral noise effects during pile installation and alter its behavioral pattern. Due to the mobility of sea turtles and sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors. In addition, sawfish and turtles will be able to resume normal activities during quiet periods between pile installations (i.e., 1-2 days between pile set ups), and at night. Therefore, we anticipate any behavioral effects will be insignificant.

Based on our noise calculations, the use of a water jet to install FRP piles (14-in diameter) for the bridge's fender system will not result in injurious noise effects or behavioral noise effects as the noise levels from this activity will be below all NMFS-accepted injury and behavioral disturbance thresholds[2].

Based on our noise analysis, the vibratory hammer installation of FRP piles will not cause peak-pressure or cSEL injury to sea turtles or sawfish. The peak-pressure noise level at the source

[2] NMFS 2014. Regional General Permit SAJ-82 (SAJ-2007-1590), Florida Keys, Monroe County, Florida.

(i.e., immediately next to active vibratory driving) will be approximately 186 dB, while the NMFS-accepted peak-pressure injury threshold is 206 dB. The maximum cSEL at the source will be approximately 215 dB, while the NMFS-accepted cSEL injury threshold for vibratory pile driving is 234 dB. The applicant's compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, will provide an additional measure of protection by causing the installation activities to stop if sea turtles or sawfish are spotted within 50 ft of operations. Thus, injury to sea turtles and smalltooth sawfish from the vibratory hammer installation of 14-in diameter FRP piles is extremely unlikely and the risk is discountable.

Based on our noise calculations, the vibratory installation of FRP piles could cause behavioral disturbance effects at radii of 15 ft from the source for sea turtles and 71 ft from the source for sawfish. The 15-ft radius marks the point at which the RMS noise level drops below the NMFS-accepted RMS behavioral disturbance threshold of 160 dB for sea turtles, and the 71-ft radius marks the point at which the RMS noise level drops below the NMFS-accepted RMS behavioral disturbance threshold of 150 dB for sawfish. If an individual chooses to remain within the behavioral disturbance zone, it could be exposed to behavioral noise effects during pile installation and alter its behavioral pattern. Due to the mobility of sea turtles and sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors. In addition, these species will be able to resume normal activities during quiet periods between pile installations. Therefore, we anticipate any behavioral effects will be insignificant.

3.2 Species Likely to be Adversely Affected

Johnson's Seagrass

Although the project is not in Johnson's seagrass designated critical habitat, it is expected that the project will directly impact approximately 0.02 acre (ac) of Johnson's seagrass and indirectly impact 0.02 ac of Johnson's seagrass, and will therefore adversely affect Johnson's seagrass. NMFS listed Johnson's seagrass as threatened under the ESA on September 14, 1998. Kenworthy (1993; 1997; 2000) and NMFS (2002; 2007) discuss the results of numerous field studies and summarize an extensive literature review regarding the status of Johnson's seagrass. In addition to the published literature, the Johnson's Seagrass Recovery Implementation Team (Recovery Team) is in the process of updating the 2002 Recovery Plan for Johnson's Seagrass. The updated Recovery Plan will contain the latest information concerning the status of this species and potential threats to its persistence and recovery. The following discussion summarizes those findings relevant to our evaluation of the proposed action.

Life History and Population Biology

Based on the current knowledge of the species, Johnson's seagrass reproduction is believed to be entirely asexual, and dispersal is by vegetative fragmentation. Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys in the Indian River Lagoon have not discovered male flowers, fertilized ovaries, fruits, or seeds, either in the field or under laboratory conditions (Hammerstrom and Kenworthy 2002; Jewett-Smith et al. 1997; NMFS 2007). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting either that the species does not reproduce sexually or that the male flowers are difficult to observe or describe, as noted for other *Halophila* species

(Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean.

Throughout its range, Johnson's seagrass occurs in dynamic and disjunctive patches. It spreads rapidly, growing horizontally from dense apical meristems with leaf pairs having short life spans (Kenworthy 1997). Kenworthy suggested that the observed horizontal spreading, rapid growth patterns, and high biomass turnover could explain the dynamic patches observed in distribution studies of this species. While patches may colonize quickly, they may also disappear rapidly. Sometimes they will disappear for several years and then re-establish, a process referred to as "pulsating patches" (Heidelbaugh et al. 2000; Virnstein and Hall 2009; Virnstein and Morris 2007). Mortality, or the disappearance of patches, can be caused by a number of processes, including burial from bioturbation and sediment deposition (Heidelbaugh et al. 2000), erosion, herbivory, desiccation, and turbidity. In the absence of sexual reproduction, one possible explanation for the pulsating patches is dispersal and re-establishment of vegetative fragments, a process that commonly occurs in aquatic plants, and has been demonstrated in other seagrasses (Di Carlo et al. 2005; Philbrick and Les 1996), and was also confirmed by experimental mesocosm[3] studies with Johnson's seagrass (Hall et al. 2006).

Johnson's seagrass is a shallow-rooted species and vulnerable to uprooting by wind, waves, storm events, tidal currents, bioturbation, and motor vessels. It is also vulnerable to burial by sand movement and siltation (Heidelbaugh et al. 2000). Having a canopy of only 2 cm -5 cm, it may be easily covered by sediments transported during storms or redistributed by macrofaunal bioturbation during the feeding activities of benthic organisms. Mesocosm experiments indicate that clonal fragments can only survive burial for up to a period of 12 days (W.J. Kenworthy, CCFHR, NOAA, Beaufort, North Carolina, 1997 unpublished). Mechanisms capable of disturbing patches may create clonal fragments that become dispersed. Hall et al. (2006) showed that drifting fragments of Johnson's seagrass can remain viable for 4 to 8 days, during which time they can settle, root, and grow. The process of asexual fragmentation can occur year-round. Fragments could drift several kilometers under the influence of wind and tidally-driven circulation, providing potential recruits for dispersal and new patch formation. In the absence of sexual reproduction, these are likely to be the most common forms of dispersal and patch maintenance.

Population Status and Distribution

Johnson's seagrass occurs in a variety of habitat types, including on intertidal wave-washed sandy shoals, on flood deltas near inlets, in deep water, in soft mud, and near the mouths of canals and rivers, where presumably water quality is sometimes poor and where salinity fluctuates widely. It is an opportunistic plant that occurs in a patchy, disjunctive distribution from the intertidal zone to depths of approximately 2 to 3 meters (m) in a wide range of sediment types, salinities, and in variable water quality conditions (NMFS 2007).

Johnson's seagrass exhibits a narrow geographical range of distribution and has only been found growing along approximately 200 kilometer (km) of coastline in southeastern Florida north of Sebastian Inlet, Indian River County, south to Virginia Key in northern Biscayne Bay, Miami-

[3] A mesocosm is an experimental tool that brings a small part of the natural environment under controlled conditions.

Dade County. This apparent endemism suggests that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world. Kenworthy (Kenworthy 1999; Kenworthy 1997) confirmed its limited geographic distribution in patchy and vertically disjunctive areas throughout its range. Two survey programs have monitored the presence and abundance of Johnson's seagrass within this range. One program, conducted by the St. Johns River Water Management District since 1994, continues to survey the northern section of the species' geographic range between Sebastian Inlet and Jupiter Inlet (Virnstein and Hall 2009; Virnstein and Morris 2007). The second survey, initiated in 2006, monitored the southern range of the species between Jupiter Inlet and Virginia Key in Biscayne Bay (Kunzelman 2007). This survey is no longer conducted. Since the last status review (NMFS 2007), there have not been any reported reductions in the geographic range of the species. In fact, the St. Johns River Water Management District observed Johnson's seagrass approximately 21 km north of the Sebastian Inlet mouth on the western shore of the Indian River Lagoon, a discovery that slightly extends the species' known northern range (Virnstein and Hall 2009).

Johnson's seagrass is a perennial species (meaning it lasts for greater than 2 growing seasons), showing no consistent seasonal or year-to-year pattern based on the northern transect surveys, but has exhibited some winter decline (NMFS 2007). However, during exceptionally mild winters, Johnson's seagrass can maintain or even increase in abundance from summer to winter. In the surveys conducted between 1994 and 2007, it occurred in 7.1% of the l m^2 quadrats in the northern range. Depth of occurrence within these surveys ranged from 0.03 to 2.5 m. Where it does occur, its distribution is patchy, both spatially and temporally. It frequently disappeared from transects only to reappear several months or several years later (NMFS 2007).

Based on the results of the southern transect sampling, it appears there is a relatively continuous, although patchy, distribution of the species from Jupiter Inlet to Virginia Key (NMFS 2007). The largest reported contiguous patch of Johnson's seagrass in the southern range was observed in Lake Worth Lagoon and was estimated to be 30 ac (Kenworthy 1997). Eiseman and McMillan (1980) documented Johnson's seagrass in the vicinity of Virginia Key (latitude 25.75°N); this location is considered the southern limit of the species' range. There have been no reports of this species further south of the currently known southern distribution. The presence of Johnson's seagrass in northern Biscayne Bay (north of Virginia Key) is well documented. In addition to localized surveys, the presence of Johnson's seagrass has been documented by various field experiences and observations of the area by federal, state, and county entities. Johnson's seagrass has been documented in various U.S. Army Corps of Engineer (USACE) and U.S. Coast Guard (USCG) permit applications reviewed by NMFS. Findings from the southern transect sampling (summer 2006 and winter 2007) show little difference in the species' frequency or abundance between the summer and winter sampling period. The lower frequencies of Johnson's seagrass occurred at those sites where larger-bodied seagrasses (e.g., turtle grass, *Thalassia testudinum*, and manatee grass, *Syringodium filiforme*) were more abundant (NMFS 2007). The southern range transect data support some of the conclusions drawn from previous studies and other surveys. This is a rare species; however, it can be found in relatively high abundance where it does occur. Based on the results of the southern transect sampling, it appears that, although it is disjunctively distributed and patchy, there is some continuity in the southern distribution, at least during periods of relatively good environmental conditions and no significant large-scale disturbances (NMFS 2007).

Information on the species' distribution and results of limited experimental work suggest that Johnson's seagrass has a wider tolerance range for salinity, temperature, and optical water quality conditions than other species such as paddle grass, *Halophila decipiens* (Dawes et al. 1989) (Kenworthy and Haunert 1991); (Gallegos and Kenworthy 1996); (Durako et al. 2003; Kenworthy and Fonseca 1996; Torquemada et al. 2005). Johnson's seagrass has been observed near the mouths of freshwater discharge canals (Gallegos and Kenworthy 1996), in deeper turbid waters of the interior portion of the Indian River Lagoon (Kenworthy 2000; Virnstein and Morris 2007), and in clear water associated with the high energy environments and flood deltas inside ocean inlets (Heidelbaugh et al. 2000; Kenworthy 1993; Kenworthy 1997; Virnstein and Morris 2007; Virnstein et al. 1997). It can colonize and persist in high-tidal energy environments and has been observed where tidal velocities approach the threshold of motion for unconsolidated sediments (35-40 cm s^{-1}). The persistent presence of high-density, elevated patches of Johnson's seagrass on flood tidal deltas near inlets suggests that it is capable of sediment stabilization. Intertidal populations of Johnson's seagrass may be completely exposed at low tides, suggesting high tolerance to desiccation and wide temperature tolerance.

In Virnstein's study areas within the Indian River Lagoon, Johnson's seagrass was found associated with other seagrass species or growing alone in the intertidal, and, more commonly, at the deep edge of some transects in water depths down to 180 cm. In areas in which long-term poor water and sediment quality have existed until recently, Johnson's seagrass appears to occur in relatively higher abundance, perhaps due to the inability of the larger species to thrive. Johnson's seagrass appears to be out-competed in seagrass habitats where environmental conditions permit the larger seagrass species to thrive (Kenworthy 1997; Virnstein et al. 1997). When the larger, canopy-forming species are absent, Johnson's seagrass can grow throughout the full seagrass depth range of the Indian River Lagoon (NMFS 2007; Virnstein et al. 2009).

Observations by researchers have suggested that Johnson's seagrass exploits unstable environments or newly-created unvegetated patches by exhibiting fast growth and support for all local ramets in order to exploit areas in which it could not otherwise compete. It may quickly recruit to locally uninhabited patches through prolific lateral branching and fast horizontal growth. While these attributes may allow it to compete effectively in periodically disturbed areas, if the distribution of this species becomes limited to stable areas it may eventually be outcompeted by more stable-selected plants represented by the larger-bodied seagrasses (Durako et al. 2003). In addition, the physiological attributes of Johnson's seagrass may limit growth (i.e., spreading) over large areas of substrate if the substrate is somehow altered (e.g., dredged to a depth that would preclude future recruitment of Johnson's seagrass); therefore, its ability to recover from widespread habitat loss may be limited. The clonal and reproductive growth characteristics of Johnson's sea grass result in its distribution being patchy, non-contiguous, and temporally fluctuating. These attributes suggest that colonization between broadly disjunctive areas is likely difficult and that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means.

Threats

The emerging consensus among seagrass experts on the Recovery Team is that the possibility of mortality due to reduced salinity over long periods of time is the most clearly identified threat to the species' long-term persistence. Some studies have shown that Johnson's seagrass has a wide tolerance for salinity. Conversely, short-term experiments have shown reduced photosynthesis and increased mortality at low salinities (<10 psu [practical salinity units, equivalent to parts per thousand]). Longer duration mesocosm experiments have resulted in 100% mortality of Johnson's seagrass after 10 days at salinities <10 psu (Kahn and Durako 2008). The Recovery Team has determined that the most significant threat to the species is the present or threatened destruction, modification, or curtailment of its habitat or range through water management practices and stochastic environmental factors that can alter the salinity of its habitat. Given that it is not uncommon for salinities to decline below 15 to 20 psu in its range (Steward et al. 2006), and that a number of natural and human-related factors can affect salinity throughout its range, the Recovery Team identified reduced salinity as a potential significant threat to the species because the potential for long-term mortality over a large scale could counteract the life history strategy the species uses to persist in the face of numerous, ongoing, environmental impacts. In previous reviews, including the critical habitat listing rule and the 2002 Recovery Plan, several additional factors were considered threats: (1) dredging and filling, (2) construction and shading from in-and over-water structures, (3) propeller scarring and anchor mooring, (4) trampling, (5) storms, and (6) siltation. In reviewing all information available since the original listing, the Recovery Team conducted assessments of each of these factors and has been unable to confirm that any of these pose a significant threat to the persistence and recovery of the species. A brief discussion of these factors follows.

Routine maintenance dredging associated with the constant movement of sediments in and around inlets may affect seagrasses by direct removal, light limitation due to turbidity, and burial from sedimentation. The disturbance of sediments can also destabilize the benthic community. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson's seagrass and its habitat through direct removal of the plants, fragmentation of habitat, shading, turbidity, and sedimentation. Although dredge-and-fill activities can and do adversely affect Johnson's seagrass and its designated critical habitat, these activities and the construction of in- and over-water structures are closely scrutinized through federal, state, and local permitting programs. The USACE, under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, has federal authority over the issuance of dredge-and-fill permits. This permitting process includes language to protect and conserve seagrasses through field evaluations, consultations, and recommendations to avoid, minimize, and mitigate for impacts to seagrasses.

The USACE's State (Florida) Programmatic General Permit (SPGP) authorizes permits for in-water construction activities: shoreline stabilization projects; construction of boat ramps, boat launch areas and structures associated with such ramps or launch areas; docks, pier associated facilities, and other minor piling-supported structures, and; maintenance dredging of canals and channels. The previous SPGP (January 1, 2000 to March 31, 2009) was utilized 19,927 times, of which 52% was for single-family docks (Stu Santos, USACE, pers. comm. to J. Cavanaugh, NMFS PRD, November 2012). The USACE requested reinitiation of SPGP on October 30, 2009. NMFS completed a new biological opinion July 25, 2011 authorizing the use of SPGP through July 25, 2016.

The SPGP does not allow construction in Johnson's seagrass critical habitat. For a dock to be authorized under the SPGP, the applicant must fully comply with the USACE's and NMFS's October 2002 *Key for Construction Conditions for Docks or Other Minor Structures Constructed in or Over Johnson's Seagrass (Halophila johnsonii)* and the associated August 2001 *Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh, or Mangrove Habitat*. Additional project design criteria apply to the SPGP (e.g., docks must be $\leq 1{,}000\ ft^2$). The Recovery Team has worked with NMFS's Protected Resources Division (PRD) and Habitat Conservation Division staff to develop and improve guidelines for site monitoring methods (Greening and Holland 2003), dock construction guidelines (Shafer et al. 2008), and best management practices to minimize the impact of docks on Johnson's seagrass (Landry et al. 2008).

Shafer et al. (2008) emphasized avoidance of seagrasses as a first priority in their study evaluating the regulatory construction guidelines to minimize impacts to seagrasses from single-family residential dock structures in Florida and Puerto Rico. While most dock construction is subject to the construction guidelines (i.e., the USACE's and NMFS's jointly-developed October 2002 *Key for Construction Conditions for Docks or Other Minor Structures Constructed in or over Johnson's Seagrass* and the 2001 guidelines), some docks meeting certain provisions are exempt from state permitting[4] and contribute to loss of Johnson's seagrass through construction impacts and shading. In Florida, the USACE's SPGP authorizes permits for the construction of docks, boat ramps, piers, maintenance dredging, and the construction of other minor over-water structures. The USACE is required to consult with NMFS in order to implement the SPGP; therefore, anticipated effects to Johnson's seagrass from implementation of the SPGP would be considered during ESA consultation between the USACE and NMFS. NMFS provides conservation recommendations in this Biological Opinion that if implemented, would benefit Johnson's seagrass.

The Recovery Team has identified weaknesses in the oversight practices of state and federal agencies in the permitting process for some or all of the activities discussed above, due to budget, staffing, and technological limitations. The need for post-construction permit compliance and enforcement for dock structures in Florida and Puerto Rico has been discussed in Shafer et al. (2008). The Recovery Team also identified difficulties in monitoring Johnson's seagrass—a rare and patchily-distributed species—in single-event surveys associated with permit applications, and continues to work with collaborators to improve monitoring methods. While it is recognized that dredging and filling projects and construction and shading from in- and over-water structures can adversely affect Johnson's seagrass and its habitat, the Recovery Team determined that these activities are typically local and small-scale. The deficiencies in the permitting process were not presently a significant threat to the survival of Johnson's seagrass because they will not individually or cumulatively result in long-term, large-scale mortality of Johnson's seagrass, nor preclude the species from its strategy of recolonizing areas.

Propeller scarring and improper anchoring are known to adversely affect seagrasses (Kenworthy et al. 2002a; Sargent et al. 1995). These activities can severely disrupt the benthic habitat by uprooting plants, severing rhizomes, destabilizing sediments, and significantly reducing the viability of the seagrass community. Propeller dredging and improper anchoring in shallow

[4] http://www.dep.state.fl.us/central/Home/SLERP/Docks/sfdock.pdf

areas are major disturbances to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity within Florida. The Florida Department of Highway Safety and Motor Vehicles (http://www.flhsmv.gov/html/safety.html) reported 963,057 registered commercial and recreational vessels (including canoes) statewide in fiscal year (FY) 2007. Registrations declined to 787,780 in FY 2012, likely due to the economic downturn. However, this number is likely to increase based on Florida's projected population growth from 18 million in 2006 to 25 million in 2025 (www.propertytaxreform.state.f1/docs/eo06141.pdf). An increase in the number of registered vessels will likely lead to an increase in adverse effects to seagrasses caused by propeller dredging/scarring.

Other indirect effects associated with motor vessels include turbidity from operating in shallow water, dock construction and maintenance, marina expansion, and inlet maintenance dredging. These activities and impacts are also likely to increase (NMFS 2007). Damage to seagrasses from propeller scarring and improper anchoring by motor vessels is recognized as a significant resource management problem in Florida (Sargent et al. 1995). A number of local, state, and federal statutes protect seagrasses from damage due to vessel impacts, and a number of conservation measures, including the designation of vessel control zones, signage, mooring fields, and public awareness campaigns, are directed at minimizing vessel damage to seagrasses. Despite these efforts, vessel damage can have significant local and small-scale (1 m^2 to 100 m^2) impacts on seagrasses (Kirsch et al. 2005), but there is no direct evidence that these small-scale local effects are so widespread that they are a threat to the persistence and recovery of Johnson's seagrass.

Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat, but is a lesser concern. Trampling damages seagrasses by pushing leaves into the sediment and crushing or breaking the leaves and rhizomes. Since the designation of critical habitat, however, there have been no documented observations or reports of damage by trampling, and if there were, they would be small-scale and local. Therefore, the Recovery Team determined that trampling does not constitute a significant threat to the survival or recovery of Johnson's seagrass.

Large-scale weather events such as tropical storms and hurricanes, while often generating runoff conditions that decrease water quality, also produce conditions (wind setup and abrupt water elevation changes) that can increase flushing rates. The effects of storms can be complex. There are several specifically documented storm effects on seagrasses: (1) scouring and erosion of sediments; (2) erosion of seeds and plants by waves, currents, and surge; (3) burial by shifting sand; (4) turbidity; and (5) discharge of freshwater, including inorganic and organic constituents in the effluents (Steward et al. 2006). Storm effects may be chronic, e.g., due to seasonal weather cycles, or acute, such as the effects of strong thunderstorms or tropical cyclones. Studies have demonstrated that healthy, intact seagrass meadows are generally resistant to physical degradation from severe storms, whereas damaged seagrass beds may not be as resilient (Fonseca et al. 2000; Whitfield et al. 2002). In the late summer and early fall of 2004, four hurricanes passed directly over the northern range (with wind strengths at landfall from <39 to 120 miles per hour) of Johnson's seagrass in the Indian River Lagoon. A post-hurricane random survey in the area of the Indian River Lagoon affected by the four hurricanes indicated the presence of Johnson's seagrass was similar to that reported by the St. Johns River Water

Management District (SJRWMD) transect surveys prior to the storms. This indicates that while the species may temporarily decline, under the right conditions it can return quickly (Virnstein and Morris 2007). Furthermore, despite evidence of longer-term reductions in salinity, increased water turbidity, and increased water color associated with higher than average precipitation in the spring of 2005, there was no evidence of long-term chronic impacts to seagrasses and no direct evidence of damage to Johnson's seagrass that could be considered a threat to the survival of the species (Steward et al. 2006).

Silt derived from adjacent land and shoreline erosion, river and canal discharges, inlets, and internally re-suspended materials can lead to the accumulation of material on plant leaves causing light deprivation. Deposition of silt can also lead to the burial of plants, accumulation of organic matter, and anoxic sediments. Johnson's seagrass grows in a wide range of environments, including those that are exposed to siltation from all the potential sources. Documentation of the direct effects of siltation on seagrasses is generally unavailable. The absence of seagrass has been associated with the formation of muck deposits, however, and localized areas of flocculent, anoxic sediments in isolated basins and segments of the Indian River Lagoon have been observed. Furthermore, sustained siltation experimentally simulated by complete burial for at least 12 days may cause mortality of Johnson's seagrass (W.J. Kenworthy, CCFHR, NOS, Beaufort, North Carolina, unpublished data). In general, the effects of siltation are localized and not widespread and are not likely to threaten the survival of the species.

In addition to the six factors discussed above, we also consider the effects of altered water quality on Johnson's seagrass. Availability of light is one of the most significant environmental factors affecting the survival, growth, and distribution of seagrasses (Abal et al. 1994; Bulthuis 1983; Dennison 1987; Kenworthy and Fonseca 1996). Water quality and the penetration of light are affected by turbidity (suspended solids), color, nutrients, and chlorophyll, and are major factors controlling the distribution and abundance of sea grasses (Dennison 1987; Kenworthy and Fonseca 1996) (Kenworthy and Haunert 1991). Increases in color and turbidity values throughout the range of Johnson's seagrass generally are caused by high flows of freshwater discharged from water management canals, which can also reduce salinity. Wastewater and storm water discharges, as well as from land runoff and subterranean sources, are also causes of increased turbidity. Degradation of water quality due to increased land use and poor water management practices continues to threaten the welfare of seagrass communities. Declines in water quality are likely to worsen, unless water management and land use practices can curb or eliminate freshwater discharges and minimize inputs of sediments and nutrients. A nutrient-rich environment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural runoff stimulates increased algal growth that may smother or shade Johnson's seagrass, or shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

A long-term monitoring program implemented by the SJRWMD assessed overall estuarine water quality in the northern and central region of Johnson's seagrass geographic range as mostly good (67%)(Winkler and Ceric 2006). Only 28% of the stations sampled had fair water quality, while 6% had poor quality. Fifty percent of the sampled estuarine sites were improving, while 6% were degrading, so many more sites were improving than were degrading. Forty-two percent of the lagoon sites had an insignificant trend while 3% had insufficient data to determine a trend.

As water management experts have now become confident in the association between water quality and seagrass depth distribution, they have begun establishing water quality targets for the Indian River Lagoon based on seagrass as an indicator (Steward et al. 2005). There is a strong positive correlation between seagrass depth distribution and water quality, which enables managers to predict where seagrasses will grow based on water quality and the availability of light. Given that at least half of the sampling stations were indicating long-term improvements in water quality, it can be assumed that seagrass abundance should not be negatively impacted if water and land use management programs continue to be effective. For example, carefully controlling or reducing water flows from discharge canals will moderate salinity fluctuations and reduce turbidity, color, and light attenuation values.

There has not been a comprehensive assessment of water quality published or reported for the southern geographic range of Johnson’s seagrass similar to the St. Johns River Water Management District (SJRWMD) study performed in the northern and central range. However, water quality experts at the South Florida Water Management District (SFWMD) confirm that efforts are underway to synthesize water quality information and to gain a more comprehensive understanding of the long-term status and trends of water quality in the southern range of Johnson’s seagrass (Dan Crean, SFWMD, pers. comm. to Sarah Heberling, NMFS PRD, March 2011). Of particular concern is an assessment of the impacts of fluctuations in water quality corresponding with variation in climatology, especially “wet years” versus “dry years” variation. Future recovery efforts should include close coordination with the SFWMD and county environmental management agencies in Palm Beach and Dade Counties to evaluate the status and trends of water quality in these regions of the species’ distribution.

Climate Change Effects on Seagrasses

Here, we consider the possible effects of climate change (i.e., rising temperatures and sea levels) on seagrasses in general and on Johnson’s seagrass in particular. Earth’s climate is projected to warm between 2° and 4°C by 2100, and similar projections have been made for marine systems (Sheppard and Rioja-Nieto 2005). At the margins of temperate and tropical bio-regions and within tidally-restricted areas where seagrasses are growing at their physiological limits, increased temperatures may result in losses of seagrasses and/or shifts in species composition (Short et al. 2007). The response of seagrasses to increased water temperatures will depend on the thermal tolerance of the different species and their optimum temperature for photosynthesis, respiration, and growth (Short and Neckles 1999). With future climate change and potentially warmer temperatures, there may be a 1-5 m rise in the seawater levels by 2100 when taking into account the thermal expansion of ocean water and melting of ocean glaciers. Rising sea levels may adversely impact seagrass communities due to increases in water depths above present meadows, reducing available light. Climate change may also reduce light by shifting weather patterns to cause increased cloudiness. Changing currents may cause erosion, increased turbidity and seawater intrusions higher up on land or into estuaries and rivers, which could increase landward seagrass colonization (Short and Neckles 1999). A landward migration of seagrasses with rising sea levels is a potential benefit, so long as suitable substrate is available for colonization.

It is uncertain how Johnson’s seagrass will adapt to rising sea levels and temperatures. Much depends on how much and how quickly temperatures increase. For example, Johnson’s seagrass that grows intertidally (e.g., in some parts of the Lake Worth Lagoon) may be affected by a slight change in temperature (since it may already be surviving under less than optimal conditions). However, this may be ameliorated with rising sea levels, assuming Johnson's seagrass would migrate landward with rising sea levels and assuming that suitable substrate would be available for a landward migration. However, rising sea levels could also adversely impact seagrass communities due to increases in water depths above existing meadows reducing available light.

Reduction in light availability may benefit some seagrass species (e.g., *Halophila* species) that require less light compared to the larger, canopy-forming species; therefore, much depends on the thermal tolerance of the different seagrass species and their optimum temperature for photosynthesis, respiration, and growth (Short and Neckles 1999). While sea level has changed many times during the evolutionary history of Johnson's seagrass, it is uncertain how this species will fare when considering the combined effects of rising temperatures and sea levels in conjunction with other stressors such as reduced salinity from freshwater runoff. It has been shown that evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation.

3.2.1 Status Summary

Based on the results of 14 years of monitoring in the species' northern range (1994-2007) and three years of monitoring in the species' southern range (2006-2009), there has been no significant change in the northern or southern range limits of Johnson's seagrass (NMFS 2007). It appears that the populations in the northern range are stable and capable of sustaining themselves despite stochastic events related to severe storms (Steward et al. 2006) and fluctuating climatology. Longer-term monitoring data are needed to confirm the stability of the southern distribution of the species (NMFS 2007). However, based on the results of the southern transect sampling, it appears there is a relatively continuous, although patchy, distribution of Johnson's seagrass from Jupiter Inlet to Virginia Key, at least during periods of relatively good environmental conditions and no significant large-scale disturbances. Larger seagrasses, predominantly turtle grass *(Thalassia testudinum),* begin to out-compete Johnson's seagrass in the southern range. While there has been a slight extension in the known northern range (Virnstein and Hall 2009), the limit of the southern range in the vicinity of Virginia Key (latitude 25.75°N) appears to be stable. There have been no reports of this species further south of the currently known southern distribution.

As discussed in the *Threats* section, the Recovery Team has determined that the possibility of mortality due to reduced salinity over long periods of time is a potential significant threat to the species. The other potential threats discussed above (i.e., dredging/filling, construction and shading from in and over-water structures, propeller scarring and anchor mooring, trampling, storms, and siltation) were determined to be local and small-scale and are not considered threats to the persistence and recovery of the species. It is uncertain how Johnson's seagrass will be affected by the synergistic effects of rising temperatures and sea levels associated with climate change (in conjunction with other stressors such as reduced salinity from freshwater runoff). However, evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation.

4 ENVIRONMENTAL BASELINE

This section is a description of the past and ongoing human and natural factors leading to the current status of Johnson's seagrass 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 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 critical habitat. This Opinion describes these activities' effects in the sections below.

Federal Actions Affecting Johnson's Seagrass in the Action Area

A wide range of activities funded, authorized, or carried out by federal agencies may affect Johnson's seagrass. These include dredging, dock/marina construction, boat shows, bridge/highway construction, residential construction, shoreline stabilization, breakwaters, and the installation of subaqueous lines or pipelines. Other federal actions (or actions with a federal nexus) that may affect Johnson's seagrass include actions by the Environmental Protection Agency and the USACE to manage freshwater discharges into waterways; regulation of vessel traffic by the U.S. Coast Guard; management of National Parks; actions regarding protected species by the USFWS; management of vessel traffic (and other activities) by the U.S. Navy; and authorization of state coastal zone management plans by NOAA's National Ocean Service.

According to NMFS's Public Consultation Tracking System database, there have been no recent ESA Section 7 consultations completed on projects with the potential to affect Johnson's seagrass and/or its designated habitat within the action area.

State, Private or Natural Actions Affecting Johnson's Seagrass in the Action Area

Recreational Vessel Traffic

Recreational vessel traffic in the range of Johnson's seagrass can result from marina and dock construction, and can impact Johnson's seagrass through improper anchoring, and propeller scarring. As discussed above, propeller scarring and improper anchoring are known to adversely affect seagrasses (Kenworthy et al. 2002b; Sargent et al. 1995). These activities can severely disrupt the benthic habitat by uprooting plants, severing rhizomes, destabilizing sediments, and significantly reducing the viability of the seagrass community. Propeller dredging and improper anchoring in shallow areas are a major disturbance to even the most robust seagrasses. Damage to seagrasses from propeller scarring and improper anchoring by motor vessels is recognized as a significant resource management problem in Florida (Sargent et al. 1995). A number of local, state, and federal statutes prohibit damaging seagrasses through vessel impacts, and a number of conservation measures, including the designation of vessel control zones, signage, mooring fields, and public awareness campaigns, are directed at minimizing vessel damage to seagrasses.

Natural Disturbances

While large-scale weather events, such as tropical storms and hurricanes, often generate runoff conditions that decrease water quality, they also produce conditions (wind setup and abrupt water elevation changes) that can increase flushing rates. The effects of storms can be complex.

Specifically documented storm effects on healthy seagrass meadows have been relatively minor: (1) scouring and erosion of sediments; (2) erosion of seeds and plants by waves, currents, and surge; (3) burial by shifting sand; (4) turbidity; and (5) discharge of freshwater, including inorganic and organic constituents in the effluents (Oppenheimer 1963; Steward et al. 2006; van Tussenbroek 1994; Whitfield et al. 2002). Storm effects may be chronic (e.g., due to seasonal weather cycles) or acute, such as the effects of strong thunderstorms or tropical cyclones.

State and Federal Activities That May Benefit Johnson's Seagrass 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 ACTION ON JOHNSON'S SEAGRASS

We believe that 0.04 ac of Johnson's seagrass is likely to be adversely affected (i.e., permanently removed) by shading and piling placement. However, no incidental take statement or reasonable and prudent measures will be issued because the ESA does not require biological opinions to contain incidental take statements for threatened plants. Yet, because the action will result in adverse effects to Johnson's seagrass, we must evaluate whether the action is likely to jeopardize the continued existence of the species (Section 7).

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 area considered in this Opinion. Future federal actions that are unrelated to the proposed action 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 area, and we are not aware of any other future state, tribal, or local private actions that are reasonably certain to occur within the action area.

Dock and marina construction will likely continue at current rates, with concomitant loss and degradation of seagrass habitat, including Johnson's seagrass. However, these activities are subject to USACE permitting and thus the ESA Section 7 consultation requirement.

Upland development and associated runoff will continue to degrade water quality and decrease water clarity necessary for growth of seagrasses. Flood control and imprudent water management practices will continue to result in freshwater inputs into estuarine systems, thereby degrading water quality and altering salinity. Long-term, large-scale reduction in salinity has been identified as a potentially significant threat to the persistence and recovery of Johnson's seagrass.

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. However, we expect that ongoing boater education programs and posted signage about the dangers to seagrass beds from propeller scarring and improper anchoring may reduce impacts to Johnson's seagrass.

7 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of Johnson's seagrass. In Section 5, we have outlined how the proposed action would affect Johnson's seagrass. Now we turn to an assessment of the species' response to these impacts, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of the affected species.

"To jeopardize the continued existence of" is defined as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). The following jeopardy analysis first considers the effects of the action to determine if we would reasonably expect the action to result in reductions in reproduction, numbers, or distribution of this species. The analysis next considers whether any such reduction would result in an appreciable reduction in the likelihood of survival and recovery of this species in the wild.

As noted in Section 5, we believe that 0.04 ac of Johnson's seagrass is likely to be adversely affected by shading and piling placement. The loss of up to 0.04 ac of Johnson's seagrass is a reduction in numbers. We do not consider such impacts threats to the survival of the species, because this project will not result in impacts to Johnson's seagrass outside of the direct footprint of this project, particularly in light of its "pulsating patches" life history strategy, which allows the species to acclimate readily to disturbed areas. This loss of Johnson's seagrass will not result in long-term mortality either in the immediate action area or on a larger scale within its range.

Reproduction will be minimally reduced by the anticipated loss of 0.04 ac of Johnson's seagrass due to shading from the bridge and removal from pile installation, but NMFS does not believe that this reproductive loss appreciably reduces the likelihood of survival of Johnson's seagrass in the wild. Johnson's seagrass will continue to reproduce and spread in the areas surrounding the bridge structure and throughout the range of Johnson's seagrass. The proposed action will not disturb Johnson's seagrass outside the action area; therefore, the reproductive potential of the species adjacent to the action area, and in this portion of its range, will persist.

The proposed action will not result in a reduction of Johnson's seagrass distribution or fragmentation of the range, since we expect Johnson's seagrass will continue to persist in the surrounding area around this project and will continue to be capable of spreading via asexual fragmentation. Therefore, the reproductive potential of the species in the action area, particularly in this portion of its range, will persist. Based on the preceding, NMFS concludes that the proposed action will not appreciably reduce the likelihood of survival of Johnson's seagrass in the wild.

Recovery for Johnson's seagrass, as described in the recovery plan, 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).

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 has been achieved. In fact, the range has increased slightly northward. Given the nature of the proposed project, we believe the proposed action will not be an impediment to achieving this recovery criterion. As previously mentioned, Johnson's seagrass is likely to persist in the surrounding areas outside of the project footprint. The proposed action will not impact the status of this objective.

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. Self-sustaining populations are present throughout the range of the species. The species' overall reproductive capacity will be only minimally reduced by the reduction in seagrass numbers resulting from the action. The proposed action is relatively small in nature and will not lead to separation of self-sustaining Johnson's seagrass patches to an extent that might lead to adverse effects to one or more patches of the species. Similarly, the proposed action will not adversely affect the availability of suitable habitat in which the species can spread/flow in the surrounding areas 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 0.04 ac for this project will not break up self-sustaining populations and that seagrass fragments will be able to drift to and over these impacted project sites. Therefore, we believe the loss of Johnson's seagrass associated with the proposed action will not impede the recovery criterion requiring that self-sustaining populations be present throughout the range at distances less than or equal to the maximum dispersal distance for the species.

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 portion of the project site will not be available for the long-term, thousands of ac of habitat are still available for long-term protection, which would include areas surrounding the action area.

Therefore, we conclude that the proposed action's adverse effects on Johnson's seagrass will not impede achieving the recovery objectives listed above and will therefore not appreciably reduce the species' likelihood of recovery in the wild.

8 CONCLUSION

We have analyzed the best available data, the current status of the species, environmental baseline, effects of the proposed action, and cumulative effects to determine whether the proposed action is likely to jeopardize the continued existence of Johnson's seagrass. Because the proposed action is not likely to appreciably reduce the likelihood of Johnson's seagrass's survival and recovery in the wild, it is our Opinion that the proposed action is not likely to jeopardize the continued existence of the species.

8.1 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 FDOT 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 GIS mapping of Johnson's and other seagrass distribution.

2. NMFS recommends that the FDOT, 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.

3. NMFS recommends that the FDOT prepare an assessment of the effects of other actions under its purview on Johnson's seagrass for consideration in future consultations. Specifically, cumulative effects from bridge replacements, roadway expansion, and other works performed by FDOT that could affect the species.

4. NMFS recommends that the FDOT promote 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 construction methodology for proposed docks located in the range of Johnson's seagrass.

5. NMFS recommends that the FDOT explore bridge and road designs that avoid and minimize impacts to Johnson's seagrass. Research regarding bridge orientation, light penetration, pile driving and spacing, and minimized cross-sectional profiles should be considered.

8.2 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.

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