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FISH AND WILDLIFE SERVICE
Florida Ecological Services Field Office

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Service Consultation Code: 04EF2000-2016-F-0245-001
Formal Consultation Initiation Date: January 22, 2021
Project: Lake Okeechobee Regulation Schedule 2008
Applicant: U.S. Army Corps of Engineers

Dear Colonel Kelly:

The U.S. Fish and Wildlife Service (Service) has received the U.S Army Corps of Engineers' (Corps) request for consultation dated January 22, 2021 for the 2008 Lake Okeechobee Regulation Schedule (LORS). This document transmits the Service's biological opinion (BO) based on our review of LORS which is located in Lee, Hendry, Glades, Okeechobee, Martin, Palm Beach, and St. Lucie counties, Florida, and our concurrences for the Corps' determinations for the West Indian manatee (*Trichecus manatus*; manatee), loggerhead sea turtle (*Caretta caretta*; nesting), leatherback sea turtle (*Dermochelys coriacea*; nesting), green sea turtle (*Chelonia mydas*; nesting), Kemp's ridley sea turtle (*Lepidochelys kempii*; nesting), hawksbill sea turtle (*Eretmochelys imbricata*; nesting), and the wood stork (*Mycteria americana*). It also includes and summarizes our concurrences for the Corps' determinations for manatee and loggerhead sea turtle critical habitats. The Service will refer to the five species of sea turtles throughout this BO collectively as "sea turtles.".

This document is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) and the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq.*). This BO supplements the 2018 BO for the LORS. This BO is based on information provided in the Corps' January 22, 2021, February 8, 2021, and March 10, 2021 biological assessments; scientific literature; meetings; and other sources of information available during our review. A complete record of this consultation is on file at the Florida Ecological Services Office in Vero Beach, Florida.

The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beach and NOAA Fisheries has jurisdiction for sea turtles in the marine environment. The Corps has assessed and consulted with NOAA Fisheries concerning potential impacts to foraging and swimming sea turtles, critical habitat in the marine environment, and all other marine species under their jurisdiction within the LORS action area in accordance with the Act.

Our analysis for sea turtles in this document will only address activities that may impact nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. Please note the provisions of this consultation do not apply to sea turtles in the marine environment, such as swimming hatchling, juvenile and adult sea turtles, or loggerhead critical habitat in the marine environment.

Consultation history

For a complete history on the development of the LORS prior to 2019, please refer to Appendix A of the 2018 LORS BO (Service 2018).

On March 22, 2019, the Corps submitted a letter to the Service requesting informal consultation to coordinate on any new information that could relate to LORS' effects on federally listed species. The agencies considered whether new information was available that would change the previous effect determinations. In part, the agencies considered materials submitted by the Center for Biological Diversity (CBD), the Calusa Waterkeeper, and the Waterkeeper Alliance as part of a 60-day notice of intent to sue dated December 19, 2018. In a letter dated June 6, 2019, the Service agreed with the Corps' determination that none of the reinitiation triggers for formal consultation under the Act were met.

On October 26, 2020, a U.S. District Judge signed an order (Order) which required the Corps to reinitiate formal consultation with the Service (Center for Biodiversity v. U.S. Army Corps of Engineers, Case No. 2:19-cv-14199-Middlebrooks [S.D.FL. Oct. 26, 2020]).

On January 22, 2021, the Corps submitted a biological assessment to the Service that evaluated the effects of the action on listed and proposed species and designated and proposed critical habitat. Subsequent biological assessments that included minor revisions were submitted to the Service on February 8, 2021 and March 10, 2021.

BIOLOGICAL OPINION

This BO supplements the 2018 LORS BO. It provides the Service's opinion as to whether LORS is likely to adversely affect or jeopardize manatees, sea turtles, or wood storks or result in adverse effects to or adversely modify manatee and loggerhead sea turtle designated critical habitats (50 CFR § 402.02).

The Corps has made the determination that LORS operations "may affect, is not likely to adversely affect" the above listed species and critical habitat. The Corps has also determined that LORS has "no effect" on the piping plover (*Charadrius melodus*) or its' critical habitat, eastern black rail (*Laterallus jamaicensis jamaicensis*), and the red knot (*Calidris canutus rufa*). As provided in the Services' Endangered Species Consultation Handbook, the "may affect, not likely to adversely affect" conclusion is appropriate when Project-related effects to the species or critical habitat are expected to be beneficial, discountable, or insignificant (Service and NOAA Fisheries 1998). Beneficial effects are contemporaneous positive effects without any adverse effects to the species or habitat. The Corps has not determined that there would be any beneficial effects from the proposed action on listed species. Insignificant effects relate to the size of the impact (and should

never reach the scale where take occurs), while discountable effects are those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (Service 1998). In reviewing and analyzing potential effects from the proposed action, the Service relies on the definitions of "insignificant" and "discountable" as guidance for determining if LORS is likely to adversely affect listed species.

DESCRIPTION OF THE PROPOSED ACTION

The tool used to manage Lake Okeechobee water levels within the Central and South Florida (C&SF) project authority is referred to as a regulation schedule, its current version being LORS. A regulation schedule such as LORS serves the limited but important function of being a guideline for engineers to use in regulating the inflow and outflow of water through various project-specific water control structures, i.e., pumps, spillways, and locks.

The Corps developed LORS in response to above average lake levels that had been experienced in preceding years. These extended periods of high-water levels within Lake Okeechobee had been identified as causing stress to the structural integrity of the Herbert Hoover Dike (HHD) that surrounds the lake, as well as the lake's natural habitat. Additionally, high water levels in the lake led to high volume freshwater releases to the Caloosahatchee and St. Lucie estuaries where freshwater flows can cause stress to marine habitats. In consideration of estuarine conditions and to accommodate for HHD structural limitations, a lower lake regulation schedule was developed.

LORS was developed to manage water movement into and out of Lake Okeechobee to meet congressionally authorized project purposes including flood control, water supply, navigation, preservation of fish, wildlife, and recreation. LORS operations are fully described in the 2008 water control plan (USACE 2008) and 2007 Supplemental Environmental Impact Statement (SEIS, USACE 2007). As part of LORS operations, periodic scientist calls are held to ensure that the most current data is used to inform Lake Okeechobee releases to meet congressionally-authorized project purposes and to avoid and minimize impacts to Service resources.

The federal action under review in this BO is water management under LORS. Congress has not authorized water quality measures as part of the Corps' management of the C&SF project. The Lake Okeechobee System Operating Manual (LOSOM) will replace the LORS and is expected to be implemented beginning in 2022. The Corps will be consulting with the Service and NOAA Fisheries on the potential effects of LOSOM on federally-listed species beginning in late 2021. Consistent with the Order requiring the Corps to reinitiate formal consultation with the Service, the scope of reinitiated consultation considers:

a. Effects of LORS operations on blue-green algae and red tide, and the effect of harmful algal blooms (HABs) in light of LORS operations, on the following species: manatees and their critical habitat, nesting sea turtles, piping plover, wood stork, and red knot. The biological assessment considered the potential following effects to the extent they relate to the Corps' action:

i. the effects of red tide and blue-green algae, including β-N-methylamino-L-alanine (BMAA), on manatees, nesting sea turtles, piping plover, wood stork, and red knot.
ii. the effects of seagrass die off on manatees and sea turtles, including how the loss of seagrass beds affects manatee behavior (i.e., foraging, movement, resting, migration, calving, and access to freshwater) and sea turtle nesting.
iii. the synergistic effects of red tide and blue-green algae on manatees, nesting sea turtles, piping plover, wood stork, and red knot.
iv. the effects of LORS water management releases, regardless of the presence of HABs, on manatees, nesting sea turtles, piping plover, wood stork, and red knot.

Action area

The action area for the LORS is defined 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 BO includes the following geographic areas identified in the Order (Center for Biodiversity v. U.S. Army Corps of Engineers, Case No. 2:19-cv-14199-Middlebrooks [S.D.FL. Oct. 26, 2020]) as the areas that may be influenced by Corps operations under LORS: Caloosahatchee River Estuary and immediate outfall area north to and including Boca Grande and south to and including San Carlos Bay and Matanzas Pass; Okeechobee water way; Lake Okeechobee; St. Lucie River Estuary and immediate outfall area in Southern Indian River Lagoon north to Hutchinson Island and south to Hobe Sound. The action area includes the following counties: Lee, Hendry, Glades, Okeechobee, Martin, Palm Beach, and St. Lucie.

STATUS OF THE SPECIES/CRITICAL HABITAT

Sea turtles

For the Status of the Species range-wide for the sea turtles, please see the Service's Programmatic BO to the Corps dated March 13, 2015, for sand placement activities in Florida found https://www.fws.gov/verobeach/SFESO/images/biologicalopinion/20150313_BO_Sand_Placement_Statewide_final.pdf

The terrestrial critical habitat designation for the loggerhead sea turtle used the term "primary constituent elements" (PCEs) to identify the key components of critical habitat that are essential to its conservation and may require special management considerations or protection. Revisions to the critical habitat regulations in 2016 (81 FR 7214-7440; 50 CFR §424) discontinued the Services' use of the term PCEs. We now rely exclusively on the term "physical or biological features" (PBFs) to refer to these key components, because it is the term used in the statute. This shift in terminology does not change how the Service conducts our analysis. In this analysis, we use the term PBFs to label the key components of critical habitat that provide for the conservation of the Loggerhead sea turtle that we labeled as PCEs in the designation rule.

Therefore, the PBFs are described as follows:

> PBF1: Suitable nesting beach habitat that has (a) relatively unimpeded nearshore access from the ocean to the beach for nesting females and from the beach to the ocean for both post-nesting females and hatchlings and (b) is located above mean high water to avoid being inundated frequently by high tides.
> PBF2: Sand that (a) allows for suitable nest construction, (b) is suitable for facilitating gas diffusion conducive to embryo development, and (c) is able to develop and maintain temperatures and a moisture content conducive to embryo development.
> PBF3: Suitable nesting beach habitat with sufficient darkness to ensure nesting turtles are not deterred from emerging onto the beach and allows hatchlings and post-nesting females to orient successfully to the sea.
> PBF4: Natural coastal processes or artificially created or maintained habitat mimicking natural conditions.

West Indian Manatee

The manatee was originally listed as endangered in 1967 (32 FR 4001) under the Endangered Species Preservation Act of 1966 (Pub. L. 89-669; 80 Stat. 926). After adoption of the Endangered Species Conservation Act of 1969 (Pub. L. 91-135; 83 Stat. 275), the listing was amended in 1970. Species listed under the Endangered Species Conservation Act, including the manatee, were subsequently grandfathered into the List of Endangered and Threatened Wildlife under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.). The manatee was reclassified from endangered to threatened on April 5, 2017. For a complete discussion of the Status of the Species, please see the final rule that was published in the federal register (82 FR 16668-16704).

Critical habitat for the manatee was designated in 1976 (41 FR 41914-41916). No specific primary or secondary constituent elements were included in the critical habitat designation. However, experts agree essential habitat features for the manatee include submerged aquatic vegetation (SAV) or seagrasses for foraging, shallow areas for resting and calving, channels for travel and migration, warm-water refuges during cold weather, and fresh water for drinking (Service 2001).

Wood stork

The Service listed the wood stork as endangered on February 28, 1984 (49 FR 7332-7335) and later reclassified the wood stork as threatened on June 30, 2014 (79 FR 37077-37103). The state of Florida recognizes the wood stork as federally-designated threatened. There is no designated critical habitat.

Wood storks have experienced an increase in their breeding population throughout the current range of Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina. This increase and the expansion of the breeding range are occurring even though habitat loss and fragmentation continues to occur (79 FR 37077 37103).

Summary of threats to the species/critical habitat

Sea turtles

Sea turtles, and their critical habitat, face a variety of natural and anthropogenic threats in the LORS action area. Natural threats include predation and loss of nesting habitat caused by beach erosion, sea level rise, tidal inundation, and hurricanes. Anthropogenic threats include beach re-nourishment projects; coastal development and shoreline armoring; disorientation caused by artificial lighting; human presence on the beach; in-water alterations, and recreational beach use by humans.

West Indian Manatee

The primary threats to manatees, as identified in the recovery plan, are collisions with watercraft, potential loss of warm-water refuges, and coastal development (Service 2001). In 2007, a status and threats assessment were conducted which confirmed that watercraft-related mortality and loss of warm-water refuges represent the largest threats to manatee persistence (Runge et al. 2007). Additional threats to the manatee were identified in a status and threats analysis conducted by the U.S. Geological Survey in 2016 that included water-control structures, entanglement by marine debris, red tide, cold-related mortality, chronic Atlantic mortality (based on a previous UME), and a reduction in carrying capacity as a result of reduced spring flow (Runge et al. 2017).

Wood stork

The primary cause of the wood stork population decline in the United States is the loss of wetland habitats or loss of wetland function resulting in reduced prey availability. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres of the wetlands lost in the southeastern United States between the mid-1970s and mid-1980s were in the Gulf-Atlantic Coastal Plain. Additional threats to the species may include invasive species, chemical contamination, urban development, highway construction, agricultural activities, and resource extraction.

ENVIRONMENTAL BASELINE

Status of the species/critical habitat within the action area

Sea turtles

The sea turtles may occur within the Gulf of Mexico and Atlantic Coasts of Florida and may use habitat within the LORS 2008 action area. In the Caloosahatchee Estuary this includes the Gulf beaches on the west side of Estero Island, Sanibel Island, Captiva Island, and Gasparilla Island, along Bunche Beach, the west side of Cayo Costa State Park, and the northern edge of Pine Island beach. In the St. Lucie Estuary this includes the Atlantic beaches on the east side of the southern Indian River Lagoon (SIRL), and on the east side of St. Lucie Inlet State Park and Hobe Sound National Wildlife Refuge. The nesting season for all species of sea turtles, as defined by the Florida Fish and Wildlife Conservation Commission (FWC), is between March 1 and

October 31. The loggerhead, green, and leatherback sea turtles more commonly nest in Florida, while the Kemp's ridley and hawksbill sea turtles are not found in Florida as often (FWC 2020a).

Between 2000 and 2019, data from the Fish and Wildlife Research Institute (FWRI), the FWC research division, determined that loggerhead and green sea turtles (2000-2019), leatherbacks (2009, 2015), and Kemp's ridley sea turtles (2011, 2018) have been nesting near the Caloosahatchee Estuary along Gasparilla Island, Bunche Beach, Captiva Island, North Captiva State Park, Cayo Costa State Park, Estero Island, Pine Island, and Sanibel Island. FWRI data determined that loggerhead, green, leatherbacks (2000-2019), and Kemp's ridley (2005, 2008, 2009) sea turtles have been nesting near the St. Lucie Estuary along Hobe Sound National Wildlife Refuge, Hutchinson Island, Jupiter Island, St. Lucie Inlet State Park, and Ft. Pierce Inlet. Near the Caloosahatchee Estuary, most of the nesting sea turtles are loggerhead, with fewer numbers of green, leatherbacks, and Kemp's ridley sea turtles. Near the St. Lucie Estuary, loggerhead and green sea turtles nest the most, followed by leatherback sea turtles, and few Kemp's ridley sea turtles (Ceriani pers. comm. December 18, 2020).

The FWRI data further shows notable nesting trends in green sea turtles on the east coast of Florida, and loggerhead sea turtles on both the west and east coasts of Florida (Ceriani pers. comm. December 18, 2020) (Tables 1 and 2). Green sea turtles nesting tends to follow a bi-annual trend of higher nesting count years followed by lower nesting count years (Ceriani pers. comm. December 19, 2020), most notable in the data on the east coast of Florida (Table 2). Loggerhead sea turtle nesting on both the west and east coasts of Florida has been increasing over time during 2000-2019 and generally peaked in 2016 (Tables 1 and 2). There was a slight decrease in nesting in 2017 and 2018, which appears to be increasing again in 2019. Experts at FWRI have confirmed that this nesting trend seen in loggerhead sea turtles in the action area was also observed state-wide (Ceriani pers. comm. January 13, 2021). Population estimates for loggerheads based on nest counts show that loggerhead populations across the state of Florida and the U.S. do not appear to be recovering despite protections put in place (Ceriani et al. 2019).

Table 1. Caloosahatchee Estuary Sea Turtle Nest Counts

	Loggerhead	Green	Leatherback	Kemp's Ridley
2015	1452	52	1	0
2016	2087	6	0	0
2017	1921	59	0	0
2018	1738	9	0	1
2019	1746	74	0	0

Table 2. St. Lucie Estuary Sea Turtle Nest Counts

	Loggerhead	Green	Leatherback	Kemp's Ridley
2015	15152	5126	762	0
2016	19350	922	492	0
2017	15120	6781	320	0
2018	15244	959	501	0
2019	15799	6889	469	0

Designated critical habitat for the loggerhead sea turtle exists within the action area in all or portions of the following critical habitat units:

- LOGG-T-FL-09 - Fort Pierce Inlet-St. Lucie Inlet: This unit consists of 35.2 kilometer (km) (21.9 miles (mi)) of island shoreline along the Atlantic Ocean and extends from Fort Pierce Inlet to St. Lucie Inlet.
- LOGG-T-FL-10 - St. Lucie Inlet-Jupiter Inlet: This unit consists of 24.9 km (15.5 mi) of island shoreline along the Atlantic Ocean and extends from St. Lucie Inlet to Jupiter Inlet.
- LOGG-T-FL-22 - Cayo Costa: This unit consists of 13.5 km (8.4 mi) of island shoreline along the Gulf of Mexico and extends from Boca Grande Pass to Captiva Pass.
- LOGG-T-FL-23 - Captiva Island: This unit consists of 7.6 km (4.7 mi) of island shoreline along the Gulf of Mexico and extends from Redfish Pass to Blind Pass.
- LOGG-T-FL-24 - Sanibel Island West: This unit consists of 12.2 km (7.6 mi) of island shoreline along the Gulf of Mexico and extends from Blind Pass to Tarpon Bay Road.

West Indian Manatee

The manatee is known to inhabit Lake Okeechobee (Service 2001) and at times, the lower Kissimmee River C-38 Canal, C-43, and C-44 canals. Surveys have been conducted by FWC statewide during specific weather conditions in the winter months from 1991 to 2019. The results from these minimum count surveys should not be relied upon for determining long-term population trends. Results from 2000 to 2007 (2008 was not surveyed) show that manatee winter sightings statewide were increasing each year both on the east and west coasts of Florida. Sightings went from on average 886 on the east coast in 2000 to 1,414 in 2007. Sightings went from on average 1,049 on the west coast in 2000 to 1,403 in 2007. No sampling was conducted in 2008 because of warmer weather. LORS was implemented in 2008. Between 2007 and 2009, manatee winter sighting increased from 1,414 on the east coast and 1,403 on the west coast in 2007 to 2,148 on the east coast and 1,654 on the west coast in 2009. From 2009 to 2019, after LORS 2008 came into effect, manatee winter sightings continued to increase on both coasts. Sightings went from 2,148 on the east coast in 2009 to 2,394 in 2019. Sightings went from on average 1,654 on the west coast in 2000 to 3,339 in 2007 (FWC 2020b).

Starting in 2011 to 2012, manatee aerial surveys were conducted to specifically target abundance of manatees in Florida, with the west coast being surveyed in February to March 2011 and the east coast sampled in March 2012. The estimated abundance of manatees in Florida between 2011 and 2012 was 6,350 manatees (2,790 west coast, 3,560 east coast) (Martin et al. 2015).

Aerial abundance surveys were again conducted in December 2015 (west coast) and December 2016 (east coast). The estimated abundance of manatees in Florida between 2015 and 2016 was 8,810 manatees (4,810 west coast, 4,000 east coast) (Hostetler et al. 2018). To date, this information represents the most recent abundance estimate for manatees.

In 2020, with the onset of summer rains in June, nutrient-laden stormwater and baseflow began affecting water quality in the Indian River Lagoon. Salinities and water clarity dropped, and algal blooms began. By late-July, much of the southern Mosquito Lagoon, the Banana River and Northern Indian River were impacted by a severe algal bloom, which continued through December. Summer seagrass monitoring in the Indian River Lagoon showed that average transect lengths in 2020 (as measured from the shoreline to the furthest extent of seagrass beds) were 30 percent shorter than those recorded in the summer of 2019 (IRLNEP 2020). During late-2020, an Unusual Mortality Event (UME) involving manatees along the Atlantic coast of Florida began to evolve. An UME is defined by NOAA fisheries as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response" (NOAA 2021).

The Service has drafted the Investigative Plan for the Atlantic coast UME investigation and is currently working with our state and federal partners to conduct analyses related to the potential cause of the UME. Although the investigation is ongoing, most of the manatee carcasses have come in from the Northern Indian River Lagoon area and in particular, Brevard County which is not in the action area. However, there are still carcasses and distressed manatees coming in from Southeast Florida, and the UME event area extends south through the action area all the way to Monroe County. There were over 625 carcasses (all causes of death) discovered in the Atlantic Management Unit between December 1, 2020 and April 18, 2021 (Calleson per. comm. 2021). Of these, approximately 32 manatee mortalities occurred within the action area. As of July 9, 2021, a total of 850 carcasses have been discovered statewide of which 48 mortalities (5.6 percent) occurred within Martin and St. Lucie counties (within the action area), 314 mortalities (40 percent) occurred outside the action area but within Brevard and Indian River counties, and the rest have occurred throughout other areas of the state. The probable cause of death for many of the manatees in Brevard and Indian River counties has been identified as starvation, likely associated with a loss of foraging habitat. Seagrass beds are still present within the St. Lucie estuary portion of the action area, and foraging conditions in this area are not believed to be responsible for the recent manatee mortalities.

A recent study was conducted to determine the concentration of glyphosate, a common herbicide, and its breakdown product, in manatee plasma and assess the exposure of manatees seeking a warm-water refuge in Crystal River and in South Florida (De Maria et. al. 2021a). The study concluded that the concentration of glyphosate had significantly increased in manatee samples from 2009 until 2019, and glyphosate and its breakdown product were ubiquitous in water bodies. However, they made no conclusions about the potential effects to manatees from exposure to glyphosate. In fact, because of concerns raised by the media and public based on their interpretations of the study, the authors later clarified that "the direct effects of glyphosate on manatee health are still undetermined but require more investigation by scientists and health professionals" (De Maria et. al. 2021b).

Designated critical habitat for the manatee within the action area includes all or portions of; 1) the Caloosahatchee River downstream from the Florida State Highway 31 bridge in Lee County, 2) all U.S. territorial waters adjoining the coast and islands of Lee County, 3) that section of the

intracoastal waterway from the town of Seawalls Point in Martin County to Jupiter Inlet in Palm Beach County, 4) the entire inland section of water known as the Indian River from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway 3 in Volusia County southward to its southernmost point near the town of Sewall's Point in Martin County.

Wood stork

The Service has mapped the wood stork nesting colonies and the nesting data per year (Service 2020). There are two known Caloosahatchee River estuary colonies, four known Lake Okeechobee nesting colonies, and two St. Lucie estuary colonies, where the colony or the associated foraging habitat overlaps with the action area. In the Caloosahatchee River estuary area, Caloosahatchee River West (26.688822, -81.830155) was last active in 2019 with 164 nests; and Caloosahatchee River East (26.696582, -81.79495) was last active in 2011 with 8 nests. In the Lake Okeechobee area, Moonshine Bay (26.922267, -81.02969) was last active in 2019 with 15 nests; Gator Farm (27.02278, -81.06084) was last active in 2019 with 35 nests; Lemkin Creek (27.206, -80.889) was last active in 2018 with 7 nests; and Cypress Creek Bluefield Road (27.288333, -80.616667) was last active in 2018 with 16 nests. In the St. Lucie estuary area, North Fork St. Lucie River (27.265984, -80.326452) was last active in 2014 with 10 nests; and Sewal Point MC2 - Bird Island (27.190364, -80.187839) was last active in 2019 with 11 nests.

EFFECTS OF THE ACTION

The Service defines "effects of the action" as all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02). As stated above, the Corps' evaluation concluded that freshwater flows from Lake Okeechobee, and the LORS 2008 operation, do not trigger red tide blooms or enhance red tide. Based on their analysis, the Service concurs with the Corps' "no effect" determinations for the eastern black rail, red knot, and piping plover and its' critical habitat.

For our effect's analysis, the Service reviewed the best available science and information to determine if we concur with the Corps' determinations that LORS "may affect, but is not likely to adversely affect" manatees, sea turtles, and wood storks or manatee and loggerhead sea turtle critical habitat. In other words, we evaluated whether the effects of the action are either insignificant (could not measure) or discountable (not likely to occur). The Service has identified three hypothetical pathways for analyzing potential effects to listed species from water releases out of Lake Okeechobee under LORS (Figures 1, 2, and 3).

Pathway 1

This hypothetical pathway can generally be described as containing the following series of interrelated events; 1) freshwater (not containing an HAB) is released from Lake Okeechobee,

2) water from local watersheds and tidal inflows combine with Lake Okeechobee freshwater, 3) this combined volume of water enters the estuaries, 4) freshwater entering the estuaries causes changes in water quality (i.e., salinity, turbidity, sedimentation, etc.), 5) changes in water quality affect seagrass growth and persistence, 6) seagrass coverage and density decreases, and 7) loss of seagrass to such an extent that adverse impacts could be measured or detected in listed species.

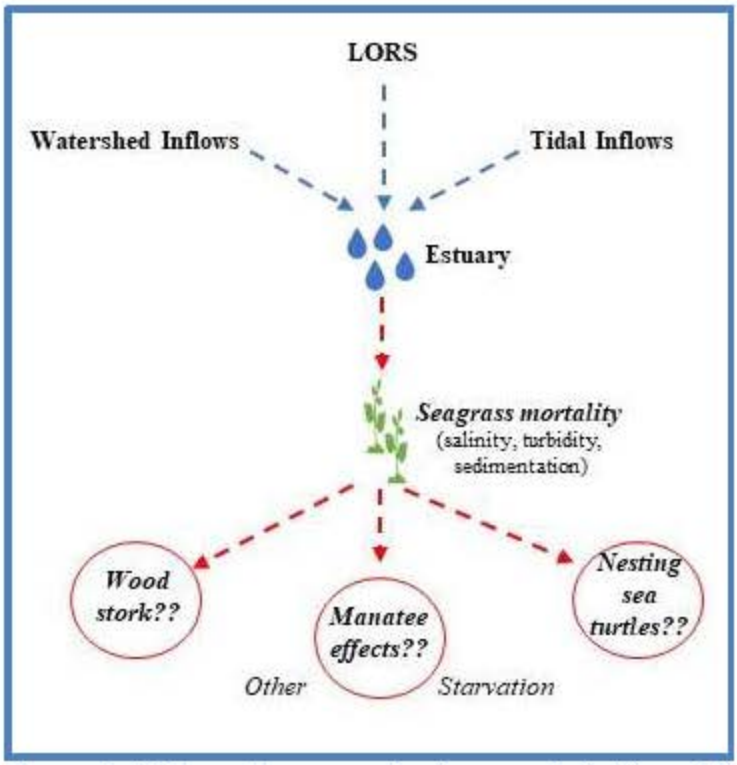

Figure 1. Pathway 1 representing the potential effects of freshwater releases from Lake Okeechobee to manatees, wood storks, and sea turtles.

Freshwater Releases

Lake Okeechobee is hydrologically connected to the Everglades, the St. Lucie estuary, Caloosahatchee River estuary, and to some degree the Atlantic Ocean and Gulf of Mexico during high flow events. Management to reduce high Lake Okeechobee stages results in the release of freshwater from Lake Okeechobee which, in combination with other local basin inflows, can carry pollutants and cause large fluctuations in salinity to both the St. Lucie and Caloosahatchee estuaries. These fluctuations often expose estuarine biota to salinity levels that are outside of their tolerance ranges (Figure 1). LORS regulation schedule was formulated to maintain flows and estuarine salinities within acceptable limits that are best for estuarine health.

Water management releases from Lake Okeechobee to the east (through the S-308 and S-80 structures) and west (through the S-77 structure) are one source of inflows to the estuaries that contain nutrients. However, inflows into the St. Lucie estuary come from many sources including LO, C-44 basin runoff (through the S-80 structure), C-23 basin runoff (through the S-97 structure), C-24 basin runoff (through the S-49 structure), Ten Mile Creek basin runoff (through Gordy Road),

and tidal basin inflows. Inflows to the Caloosahatchee estuary come from a combination of tidal inflows, C-43 basin runoff (through the S-79 structure), and Lake Okeechobee inflows.

An evaluation of freshwater flows coming from Lake Okeechobee and other parts of the watersheds was done over a 5-year period (2015 to 2019) for both the Caloosahatchee River watershed and the St. Lucie River watershed (SFWMD 2020). Lake Okeechobee releases into the Caloosahatchee estuary accounted for 38 percent of the freshwater that flows to this estuary, whereas 62 percent of the freshwater came from the surrounding watersheds. Lake Okeechobee releases into the St. Lucie estuary accounted for only 31 percent of the freshwater that flows to this estuary, whereas 69 percent of the freshwater came from the surrounding watersheds. During this same time, local basin runoff accounted for 63 percent of total nitrogen (TN) loads and 75 percent of total phosorous (TP) loads to the St. Lucie estuary. Local basin runoff accounted for 61 percent of TN loads and 70 percent of TP loads to the Caloosahatchee estuary. These data show the majority (>60 percent) of both freshwater and nutrients (TP and TN) entering the estuaries comes from the surrounding watersheds and does not originate in Lake Okeechobee. Lake Okeechobee inflows combined with basin and tidal runoff contribute to changes in salinity, water clarity (total suspended solids and color), and nutrients affecting water quality in both the Caloosahatchee and St. Lucie estuaries. Based on the above information, these changes are the result of many factors affecting environmental conditions in the estuaries, of which releases of freshwater from Lake Okeechobee under LORS represent a fraction.

Seagrass mortality

In our analysis, the Service next considered the potential effects of Lake Okeechobee releases under LORS to seagrasses located in the estuaries. Submerged aquatic vegetation (SAV), which includes seagrass and macroalgae, is one of the most important vegetation communities of the St. Lucie and Caloosahatchee estuaries (IRLNEP 2019). These communities are highly productive and provide food and habitat for fish, sea turtles, manatees, a myriad of invertebrates, and other terrestrial and marine species. Many SAV beds are stressed and have been reduced or eliminated from their former areas by extreme salinity fluctuations, increased turbidity, sedimentation, dredging, damage from boats (i.e., prop scarring), hurricane damage, and nutrient enrichment which causes algal blooms, some of which can restrict light penetration (USACE 2021).

Seagrasses can be affected (positively or negatively) by the quantity and quality of freshwater releases, as well as the timing and duration of those releases (RECOVER 2007, USACE 2011). Freshwater can be from Lake Okeechobee or the surrounding watershed, and extreme high flow events are caused by hurricanes and other large precipitation events. Large freshwater flows can cause extreme salinity fluctuations in the estuaries, and these large storm events can cause increased turbidity and sedimentation in the water column (either during the storm, or afterwards as an effect of high-volume releases). The other extreme that impacts freshwater flows from Lake Okeechobee or the surrounding watershed is during drought; the lack of freshwater inflow can cause high salinity levels in the upper estuaries. Hurricanes can also have the effect of causing increased salinities from storm surge being pushed into the lagoons and estuaries.

The Corps provided the Service a summary of recent data on the status of seagrass cover in both the Caloosahatchee and St. Lucie estuaries (USACE 2021). In their review of published data, the Corps identified many factors related to the abundance of seagrasses. These included changes in salinity,

nutrient loads, light limitation caused by turbidity, effects of hurricanes, physical effects such as seagrass burial, propeller scarring, sedimentation, and dredging. Many of the factors affecting the health and survival of seagrass are unrelated to LORS. For example, in 2017, seagrasses covered 908 acres within the two St. Lucie estuary segments located in the action area, which was down from the 2,017 acres mapped in 2015 (FWC 2018). Weather extremes of high temperatures and precipitation, beginning in the fall of 2015 and extending through 2016, and physical impacts from Hurricane Michael in 2016 likely contributed to these seagrass losses. Although seagrass cover in both the Caloosahatchee and St. Lucie estuaries has fluctuated in recent years and are likely still recovering from the 2016-2017 hurricane season, seagrass beds are still present within the action area.

As stated above, the majority (>60 percent) of both freshwater and nutrients (TP and TN) entering the estuaries comes from the surrounding watersheds and does not originate in LO. The loss of seagrass results from a combination of factors, and the factors associated with freshwater releases under LORS represent a fraction of the overall effects to this resource. Therefore, to be able to measure negative impacts to seagrasses from LORS the Service considered the following information: 1) the proportion of freshwater and nutrients entering the estuaries attributable to Lake Okeechobee releases, 2) the primary factors responsible for the loss of seagrasses in the estuaries, and 3) the proportion of those factors (i.e., nutrients, sedimentation, physical effects, salinity, etc.) that could be attributed to freshwater releases from LO. After a review of the best available information, the Service is unable to determine with any certainty the extent to which any negative impacts to seagrass cover in the estuaries could be attributable directly or indirectly to freshwater releases under LORS. This does not imply that a relationship between freshwater releases from Lake Okeechobee and seagrass mortality may not exist; however, the best scientific information available to the Service does not allow for a quantification of any potential effects. Furthermore, potential effects from Lake Okeechobee releases of freshwater are modulated by other commingling factors including watershed runoff, nutrient loading from tidal basins, physical damage from boats and hurricanes, light limitation caused by turbidity, salinity fluctuation, sedimentation, dredging, etc. and it is not practicable to predict or quantify a relationship among these commingling factors.

Listed Species Effects

The final relationship that the Service considered in Pathway 1 was potential effects to nesting sea turtles, wood storks, and manatees from seagrass mortality. Seagrass mortality does not impact nesting sea turtles while they are on the beach, nor is it expected to impact nesting sea turtles while they are in the water close to shore as sea turtles do not often eat during this life stage (Foley pers. comm. December 16, 2020). The wood stork primarily feeds on fish and aquatic and terrestrial invertebrates. The Service has not found any information that connects seagrass mortality to negative effects on wood storks. Manatees move through canals, LO, and the Caloosahatchee and St. Lucie estuaries in response to water temperature changes (daily and seasonal), food availability, human disturbance, breeding, and calving, and can move freely between salinity extremes. Manatees feed on a variety of submerged, emergent, and floating vegetation, and usually forage in shallow grass beds adjacent to deeper channels. Seagrasses appear to be a staple of the manatee diet in coastal waters (Service 2001). Therefore, a complete loss of seagrass beds within the St. Lucie or Caloosahatchee estuary could cause adverse effects to manatees.

The waters of the St. Lucie and Caloosahatchee estuaries are both designated as critical habitat for the manatee. Although no primary or secondary constituent elements were identified for manatee critical habitat, the manatee requires adequate foraging habitat (i.e., seagrass beds), shallow areas for resting and calving, channels for travel and migration, warm water refuges, and fresh water for drinking (Service 2001). The Service is not aware of any information that supports a conclusion that releases of freshwater from Lake Okeechobee have caused a reduction in seagrass cover within the action area that has subsequently resulted in adverse effects to manatees.

The Service is unable to quantify the potential relationship between freshwater releases from Lake Okeechobee and negative effects to seagrass cover (see seagrass discussion above). Therefore, it is also not currently possible to determine a "cause and effect" relationship in Pathway 1 between LORS and potential adverse effects to sea turtles, wood storks, or manatees. Seagrass cover in both the Caloosahatchee and St. Lucie estuaries have fluctuated in recent years, but seagrass beds are still present within the action area.

Summary

The best available information suggests that releases from Lake Okeechobee under LORS represents less than half (<40 percent) of the freshwater entering the estuaries. Although seagrass cover has fluctuated in the action area, seagrass beds are still present. The mortality of seagrass is caused by many factors. Based on the above information, the Service has determined that any potential effects to listed species from Pathway 1 would be insignificant or discountable.

Pathway 2

This hypothetical pathway can generally be described as containing the following series of interrelated events; 1) freshwater containing an HAB is released from LO, 2) water from local watersheds and tidal inflows combine with Lake Okeechobee freshwater, 3) this combined volume of water and HAB enters the estuaries, 4) freshwater containing the HAB enters the estuaries and causes changes in water quality (i.e., salinity, turbidity, sedimentation, etc.), 5) changes in water quality affect seagrass growth and persistence, 6) seagrass coverage and density decreases, and 7) loss of seagrass to such an extent that adverse impacts could be measured or detected in listed species. In addition, under this pathway, *Microcystis aeruginosa*, a freshwater blue-green alga, entering the estuaries could release the microcystin toxin, which then could affect manatees, wood storks, or sea turtles.

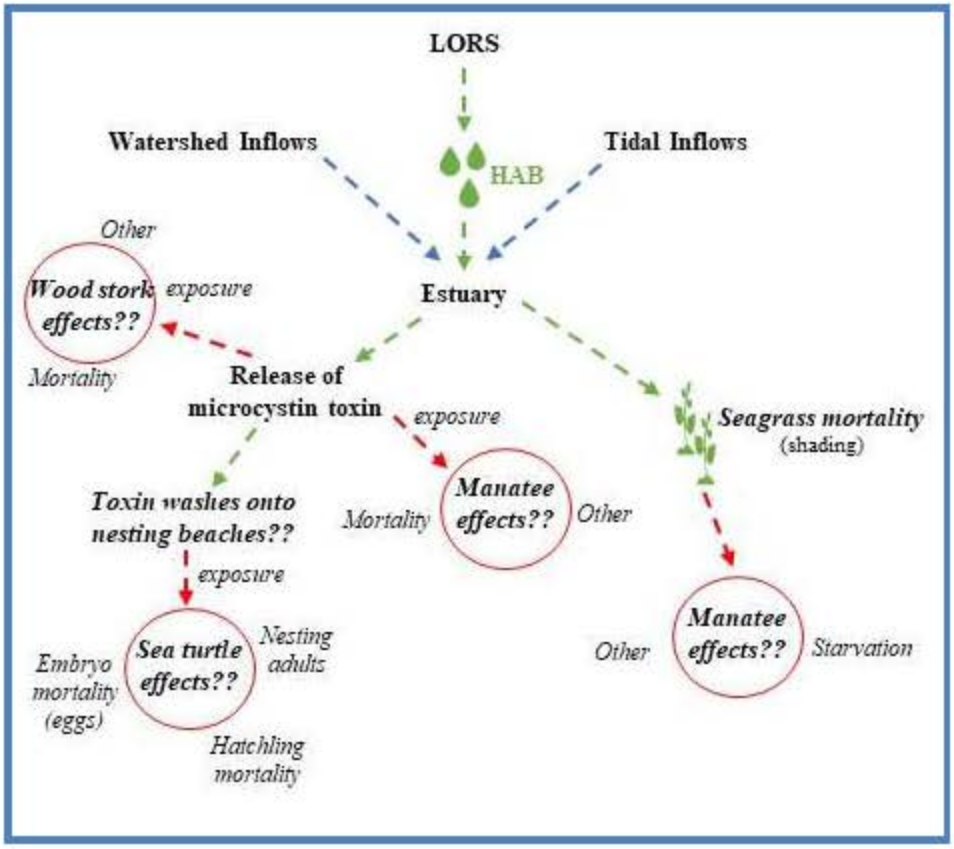

Figure 2. Pathway 2 representing the potential effects of freshwater containing a Harmful Algal Bloom (HAB) released from Lake Okeechobee to manatees, wood storks, and sea turtles.

Freshwater Releases Containing a HAB

In Pathway 2, the Service examined the potential effects of discharges from Lake Okeechobee that contained HABs. There were two mechanisms that were analyzed under Pathway 2; 1) HAB potentially causes mortality of seagrasses, and 2) toxins, primarily microcystin, released from HAB in the estuaries potentially affects listed species (Figure 2).

The Service previously described the difficulty in quantifying the potential effects of freshwater releases from Lake Okeechobee under LORS and changes to environmental conditions in the estuaries. However, when a harmful algal bloom (HAB) exists in Lake Okeechobee and that water is discharged to the estuaries, potential effects from the HAB could be attributable to LORS. HABs occur when algae produce toxic or harmful effects on people, fish, shellfish, marine mammals, and birds. HABs also include blooms of non-toxic species that have harmful effects on marine ecosystems. For example, algal blooms can cause seagrass decline because of poor water clarity which leads to poor light penetration (RECOVER 2019). Two algal groups typically constitute HABs. They include the prokaryotic cyanobacteria (*Cyanophyceae*, or blue-green algae) and dinoflagellates (*Dinophyceae*). *Microcystis aeruginosa*, a freshwater blue-green alga, is the dominant species that forms HABs on Lake Okeechobee.

Many factors contribute to the development and proliferation of algal blooms in Lake Okeechobee and during their discharge and migration from the lake to the estuaries. These factors include warm

temperatures, reduced water flow and circulation, wind driven mixing of the water column and sediments, nutrients, lack of animals that forage on algae, aquatic resource management practices, and previous occurrences of blooms (State of Florida 2015). In addition, HABs in the estuaries may be supported or further enhanced by storms. Watershed runoff can increase nutrient loads that fuel HABs or provide an additional source of HAB biomass from other freshwater ecosystems in the watershed (Philips et. al. 2020).

The Corps has identified those factors that affect the abundance of seagrasses in the Caloosahatchee and St. Lucie estuaries. These include changes in salinity, nutrient loads, light limitation caused by turbidity, effects of hurricanes, physical effects such as seagrass burial, propeller scarring, sedimentation, and dredging. Seagrass cover has fluctuated in recent years, but seagrass beds continue to persist in the estuaries. During the two most recent HABs that occurred in 2016 and 2018, it is likely that algae released into the estuaries had negative effects to seagrass cover. However, the decline in seagrass cover in 2016 was tied to dramatic salinity changes and poor water clarity but not directly to the algal bloom. The Service has not been able to find any literature or scientific studies that quantified the possible effects of HABs on seagrass in relation to effects from other, unrelated factors.

Microcystin Toxin

The second mechanism analyzed under Pathway 2 involves the potential effects resulting from the release of the microcystin toxin. Research has shown that *Microcystis aeruginosa* has a salinity tolerance up to 18 psu (Practical Salinity Units), and the microcystin toxin has been found to leak out of cells when exposed to salinities higher than this amount. Once an HAB is transported to the brackish and marine waters of the Caloosahatchee and St. Lucie estuaries, microcystin can be released into the water as the cells break down (Rosen et. al. 2018). The microcystin toxin causes tumors and damage to the liver of some animals.

Beta-Methylamino-L-alanine

In certain conditions, blue-green algae can produce a non-protein amino acid called beta-Methylamino-L-alanine (BMAA), and some have hypothesized that BMAA could be an environmental trigger to neurological disease (Banack et. al. 2010, Metcalf and Codd 2009). BMAA accumulates in some aquatic animals in areas of cyanobacteria blooms, but the authors could not discern any clear patterns (Brand et. al. 2010). However, the literature indicates that more than 95 percent of cyanobacteria genera produce BMAA (Holtcamp 2012). The studies reviewed by the Corps did not provide any conclusive evidence that BMAA found in marine and estuarine waters was from Lake Okeechobee or any source (USACE 2021).

Listed Species Effects

The last step in our analysis of Pathway 2 is determining whether the potential direct effects to seagrasses from HABs or indirect effects from the microcystin toxin may ultimately affect listed species in the action area. The potential effects from HABs on seagrasses was described above, and, just as in the case with the mortality of seagrasses associated with freshwater releases from LO, the

Service is unable to determine the amount or extent of any potential effects of HABs on seagrass cover in the estuaries because there are many factors that negatively affect seagrass communities in these areas.

The Service has considered the possible effects of the microcystin toxin to manatees, wood storks, and nesting sea turtles. Manatees forage on plants and incidentally ingest algae and other materials while feeding. The microcystin toxin could be ingested, but it is not known to cause health problems in manatees nor is it known to affect their ability to breed (Service 2019). The Service has lead responsibility for sea turtles while they are on the nesting beaches; therefore, our analysis here is limited to any potential effects to adult sea turtles, their eggs, or hatchlings while in this environment. Perrault et. al. (2020) noted that sea turtle exposure to HAB toxins is likely through their food source, but nesting sea turtles and hatchlings often do not forage while they are on nesting beaches so exposure to the microcystin toxin through their food is not likely. In addition, the Corps was not able to find any literature regarding the effect of blue-green algae or the microcystin toxin on sea turtles. It is possible that in certain conditions (i.e., high tide or flood events) the microcystin toxin could be washed onto nesting beaches during the nesting season. However, the Service has not found any evidence to support a conclusion that the microcystin toxin has caused negative effects to sea turtle eggs, hatchlings, or adults while on nesting beaches. In addition, the Service, Corps, and South Florida Water Management District have not found any literature that shows that blue-green algae have any effect on the wood stork (USACE 2021).

Portions of both the Atlantic and Gulf beaches within the action area have been designated as critical habitat for the loggerhead sea turtle. The Service identified certain critical habitat features as essential to the species survival (i.e., primary constituent elements). These features include: 1) suitable nesting beach habitat, 2) sand that is suitable for nesting, 3) suitable nesting beach habitat with sufficient darkness, and 4) natural coastal processes or artificially created or maintained habitat mimicking natural conditions. It is possible for the microcystin toxin to wash ashore on to nesting beaches, and if this were to occur when adult or hatchling loggerhead sea turtles were present, this could influence the suitability of nesting beaches. However, the Service has not found any information or studies that have shown that the microcystin toxin has been found on nesting beaches. Therefore, the Service does not believe adverse effects have occurred to loggerhead sea turtle critical habitat as a direct result of LORS operations.

Summary

Although seagrass cover has fluctuated in the action area, seagrass beds are still present. The mortality of seagrass is caused by many factors, including shading as the result of HABs. The microcystin toxin can be released from algae when the cells are degraded after entering the marine environment. The microcystin toxin has not been shown to cause negative effects to either sea turtles or manatees. BMAA, although likely present in the estuaries and marine environment, is not known to originate in Lake Okeechobee or any other source or cause negative effects to listed species. Based on the above information, the Service has determined that any potential effects to listed species from Pathway 2 would be insignificant or discountable.

Pathway 3

This hypothetical pathway can generally be described as containing the following series of interrelated events; 1) freshwater containing an HAB is released from LO, 2) water from local watersheds and tidal inflows combine with Lake Okeechobee freshwater, 3) this combined volume of water and HAB enters the estuaries, 4) HAB and nutrients enhance existing red tide, 5) red tide causes adverse effects to listed species.

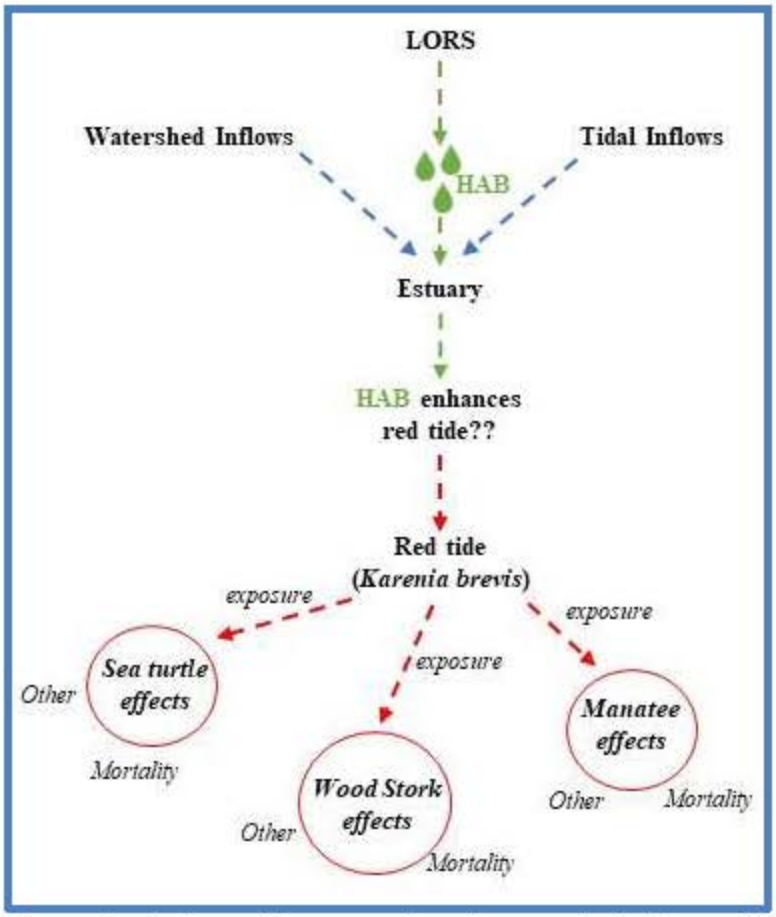

Figure 3. Pathway 3 representing the potential effects of freshwater containing a Harmful Algal Bloom (HAB) released from Lake Okeechobee, enhancing a red tide event, and causing negative effects to manatees, sea turtles, and wood storks.

Freshwater Releases Containing a HAB

In Pathway 3, the Service again examined the potential effects of discharges from Lake Okeechobee that contained HABs, but under this scenario the analysis focused on the potential effects of HABs or nutrients on red tide (Figure 3). For there to be the possibility of adverse effects to listed species that could be attributed to LORS in Pathway 3, there would need to be evidence that HABs (primarily containing *M. aeruginosa*) or nutrients from Lake Okeechobee contributed to the development of red tides or enhanced red tides. We discuss below the possibility of this relationship.

One of the best-known types of HAB is "red tide." Red tides are HABs that occur when microscopic algae in seawater proliferate to higher-than-normal concentrations. The dinoflagellate, *Karenia brevis*, is the most common red tide organism that is responsible for the red tide outbreaks along the southwest coast of Florida. The Florida red tides occur in the Gulf of Mexico almost every year, generally in the late summer or early fall. Red tide bloom outbreaks first occur offshore and are brought onshore through wind and wave action. *Karenia brevis* produces brevetoxins that can affect the central nervous system of manatees, fish and other vertebrates, causing these animals to become distressed or die. Wave action can break open *K. brevis* cells and release these toxins into the air, leading to respiratory irritation (FWC 2019).

The potential roles and sources of nutrients involved in the initiation and maintenance of red tide blooms, especially those originating in discharges from Lake Okeechobee and the S-79 structure, are of interest in our analysis. We also considered the possibility that *Karenia brevis* foraged on *M. aeruginosa*. The literature suggests that some marine species of cyanobacteria (*Synechococcus* spp.) can be a prey source, but there is no evidence that freshwater *Microcystis* cyanobacteria serve as prey for *Karenia brevis*. The available literature identified several potential sources of nutrients in support of red tide such as rain, dust, upwelling of deep nutrient rich water, dead fish, other nitrogen fixing algae, submarine ground-water discharge, and runoff from the land (USACE 2021). However, the Corps in their analysis and literature review was unable to find any correlation between Lake Okeechobee releases and red tide events. FWC and Mote Marine Laboratory state that there is not a direct link between land-based nutrient pollution and land-based runoff to the frequency and severity of red tide blooms (Heil et al. 2014, Mote 2019). In addition, the National Marine Fisheries Service (NMFS) stated in a letter to the Corps that they "found no correlation between releases and red tide events, further supporting the conclusion that there is no causal relationship between the releases and red tide" (NMFS 2020). NMFS went on further to state that the dynamics of red tide are complex, not completely understood, and dependent on numerous factors. Medina et. al. (2020) studied the relationship between nitrogen and red tide in southwest Florida but failed to link nitrogen to any upstream basin, including LO.

Listed Species Effects

The final step in our analysis under Pathway 3 is determining whether there would be adverse effects to listed species. The Service acknowledges that red tides can cause adverse effects to listed species, including manatees, sea turtles, and wood storks. However, given the fact that a review of the available literature could not find evidence that HABs or nutrients from Lake Okeechobee create or enhance red tides, the Service is unable to conclude that Pathway 3 results in adverse effects to listed species. There is little doubt that nutrient input from various sources may enhance an existing red tide; however, the Service is unable to meaningfully measure, detect, or evaluate the potential effects that Lake Okeechobee discharges under LORS may have on red tides or ultimately listed species.

Summary

There is speculation, but no evidence that HABs or nutrients originating in Lake Okeechobee enhance or contribute to the development of red tides in any measurable way. Based on the above information, the Service has determined that there is not enough information to support a conclusion that adverse effects to listed species would occur through Pathway 3.

CONCLUSION

The Service has reviewed the biological assessment submitted by the Corps and other information available at the time of writing this BO. This included all information provided in judgements and orders produced by the United States District Court, Southern District of Florida, the May 28, 2021 letter from the CBD to the Service, and all information published to the Corp's website (https://www.saj.usace.army.mil/Algae) as a result of the Order. In our review, the Service developed three hypothetical effects pathways that we believed illustrated the potential for adverse effects to occur to listed species from LORS. However, we were unable to find information that would support a conclusion that LORS is responsible for measurable, detectable, adverse effects to the manatee, sea turtles, or the wood stork, or critical habitat for the manatee and loggerhead sea turtle. Therefore, the Service concurs with the Corps determination that LORS "may affect, is not likely to adversely affect" these species and critical habitat and is not likely to result in jeopardy to these species. Because the action is not likely to adversely affect listed species based on the three effects pathways described above, we find that LORS is not likely to jeopardize the manatee, sea turtles, and the wood stork, or adversely modify critical habitat for the manatee and loggerhead sea turtle. We do not include an incidental take statement because no take is expected to occur.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act 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. The Service is not currently proposing any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on LORS. As provided in 50 CFR § 402.16, reinitiation of 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 incidental take is exceeded; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

Thank you for your cooperation and effort in protecting federally listed species and fish and wildlife resources. If you have any questions regarding this BO, please contact Timothy Breen at 772-469-4239.

Sincerely yours,

DONALD PROGULSKE Digitally signed by DONALD PROGULSKE Date: 2021.07.23 14:52:01 -04'00'

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