BIOLOGICAL OPINION

FOR THE

EVERGLADES RESTORATION TRANSITION PLAN – 2016

Service Consultation Code: 04EF2000-2015-F-0241

Submitted to:
Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

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Acronyms and Abbreviations

Abbreviation ....Definition

Act..........................Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*)
BA ....Biological Assessment
BAMM...................Baseline and Modification Model
BCNP ....Big Cypress National Preserve
BNP........................Biscayne National Park
BO ....Biological Opinion
C&SF ....Central and Southern Florida
CEPP.......................Central Everglades Planning Project
CEQ........................White House Council on Environmental Quality
CERP......................Comprehensive Everglades Restoration Plan
CFR ....Code of Federal Regulations
cfs...........................cubic feet per second
cm...........................centimeters
COP ....Combined Operational Plan
Corps.......................U.S. Army Corps of Engineers
CSSS ....Cape Sable Seaside Sparrow
CSOP.......................Combined Structural and Operational Plan
DEP ....Florida Department of Environmental Protection
District/SFWMD.....South Florida Water Management District
DOI ....Department of the Interior
EAA ....Everglades Agricultural Area
EDEN......................Everglades Depth Estimation Network
EIS..........................Environmental Impact Statement
ENP ....Everglades National Park
ERTP.......................Everglades Restoration Transition Plan, Phase 1
ERTP-2016 ....Everglades Restoration Transition Plan, 2016 Biological Opinion
ET...........................Ecological Target
FDACS....................Florida Department of Agriculture and Consumer Affairs
FDEP.......................Florida Department of Environmental Protection
FEIS ....Final Environmental Impact Statement
ft.............................feet
FONSI.....................Finding of No Significant Impact
FWC........................Florida Fish and Wildlife Conservation Commission
GDM ....General Design Memorandum
GRR ....General Re-evaluation Report
GSE.........................Ground Surface Elevation
IOP ....Interim Operating Plan
ISOP........................Interim Structural and Operational Plan
ITS..........................Incidental Take Statement
KCOL......................Kissimmee Chain of Lakes

km ....kilometer
LORS ....Lake Okeechobee Regulation Schedule
LORSS ....Lake Okeechobee Regulation Schedule Study
m ....meter
MHHW ....Mean Higher High Water
MSTS ....Multi-Species Transition Strategy
MWD ....Modified Water Deliveries
NEPA ....National Environmental Policy Act
NGVD ....National Geodetic Vertical Datum
NESRS ....Northeast Shark River Slough
NRC ....National Research Council
NWR ....National Wildlife Refuge
PSC ....Periodic Scientist Calls
PM...........................Performance Measure
PVA.........................Population Viability Analysis
ROD ....Record of Decision
RPA.........................Reasonable and Prudent Alternative
SDCS.......................South Dade Conveyance System
SFWMM ....South Florida Water Management Model
SEI...........................Sustainable Ecosystems Institute
SEIS ....Supplemental Environmental Impact Statement
Service/USFWS ......U.S. Fish and Wildlife Service
SLR ....Sea Level Rise
SPF..........................Standard Project Flood
SRS ....Shark River Slough
STA(s).....................Stormwater Treatment Area(s)
USC.........................United States Code
USGS ......................U.S. Geological Survey
USIECR ....US Institute for Environmental Conflict Resolution
WCA(s)...................Water Conservation Area(s)
WCP........................Water Control Plan
WY..........................Water Year

EXECUTIVE SUMMARY

The formal consultation associated with the current phase of the Everglades Restoration Transition Plan – 2016 (ERTP-2016) is a result of the reinitiation request by the U.S. Army Corps of Engineers (Corps) and the expiration of the ERTP Biological Opinion (BO) (January 1, 2016). The Corps, in their ERTP-2016 Supplemental Biological Assessment (BA) (dated July 24, 2015) has defined the proposed action as the continued implementation of ERTP. No changes to the current ERTP operations were proposed within the Supplemental BA. The affected species considered within this Biological Opinion include the Everglades snail kite, wood stork, and Cape Sable seaside sparrow.

The ERTP-2016 BO evaluates the Corps' proposal to continue to employ existing operational flexibilities within ERTP, including maximizing water flows through the S-12 structures from the east to the west as capacity allows. The existing operational flexibility within ERTP is intended to prioritize regulatory releases from Water Conservation Area 3A (WCA-3A) to the east in accordance with the current WCA-3A Interim Regulation Schedule in order to attenuate flows into western Shark River Slough (SRS) where Cape Sable seaside sparrow (CSSS) subpopulation A (CSSS-A) resides. Additionally, when conditions allow, the Corps is able to delay opening and/or implement early closure of the S-12A, S-343A, S-343B, S-344 and S-12B structures beyond their current restriction dates which were implemented for the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow (IOP) in 2002. Finally, ERTP includes the provision for preemptive water releases. Preemptive releases are used to create storage within WCA-3A when large adjustments to inflow into WCA-3A or large regional rainfall events are forecasted. This flexibility is intended to assist in maintaining target stages within WCA-3A and allow for flexibility in discharges through the S-12 and S-333 structures.

These flexibilities are intended to: (a) increase the number of consecutive dry days (goal of 90 or more consecutive dry days) during the breeding period (March 1 – July 15) within CSSS habitat to allow increased potential for successful breeding; and (b) help achieve an average annual 90-210 day discontinuous hydroperiod (wet days) to reduce adverse vegetation changes within CSSS habitat. The primary breeding season is typically considered March 1 through July 15, but may extend through August if conditions are favorable.

The current consultation is a continuation of a long series of actions that have been evaluated for effects to CSSS and other listed species in this area. A detailed consultation history, dating back to the mid-1980s, is provided in Appendix A of this BO. Consultation for ERTP began in 2009, with the ERTP team members from various Federal, state, county, and tribal entities meeting to discuss effects of the IOP and to develop the ERTP. The Service provided a final Biological Opinion for ERTP on November 17, 2010, and a subsequent BO Amendment on March 2, 2012, and ERTP operations were initiated in October 2012 with the signing of the Record of Decision (ROD). The incidental take provisions for the Cape Sable seaside sparrow, Everglade snail kite, and wood stork, as described in the BO, were authorized for ERTP through January 1, 2016, when the Combined Operational Plan (COP) was expected to be implemented. However, COP has not been initiated and the 2010 ERTP BO is set to expire. Through several extensions, the latest of which extended the expiration date until July 22, 2016, the Service and Corps have been able to continue work on revising the ERTP while retaining the ESA coverage afforded by the 2010 BO.

The Corps reinitiated consultation on ERTP in November, 2014, due to exceeding a measure of exempted incidental take; specifically "If the annual CSSS population estimate falls below 2,915 sparrows [mean population estimate 2001 to 2009 = 3,145 - 230]), reinitiation of consultation must occur." Based on data collected by Everglades National Park (ENP) as part of the 2014 CSSS range-wide survey, the annual population estimate of CSSS fell below the defined reinitiation trigger. If the Corps maintains the current ERTP operations as proposed, it is reasonable to expect results (e.g., longer than suitable hydroperiods in the western subpopulation and shorter than suitable hydroperiods in some of the eastern subpopulations) similar to those observed since the initiation of ERTP operations in 2012. Completion of Everglades restoration in the long-term is expected to benefit CSSS populations, primarily by shifting water flows to the east, but many projects have been delayed for years and the CSSS is in decline as water is sent to the western side of SRS into CSSS-A habitat, rather than to the east, where it historically flowed.

The two most critical performance metrics for maintaining and enhancing the chances for CSSS survival are the number of consecutive days during the CSSS nesting season (March 1 – July 15) when there is no surface water (*i.e.*, dry nesting days) and the total number of days when there is water above ground surface during the year (*i.e.*, annual discontinuous hydroperiod). Since it takes the CSSS, a ground nesting bird (nests on average are 17 cm above ground), approximately 45 days to nest and fledge young, the original ERTP BO set a target of at least 60 consecutive dry nesting days over 40 percent of the area in CSSS-A during the breeding season. This was an emergency action requirement first mandated in the 1999 Jeopardy BO for the Modified Water Deliveries to Everglades National Park, Experimental Water Deliveries Program, Canal 111 (C-111) Project, which was established to prevent extirpation of CSSS-A by achieving at least one successful nesting period per year. This requirement was retained by the Corps when they introduced their hydrologic equivalent to the 1999 RPA, named the Interim Operations Plan (IOP). However, we have continued to observe a decline in the CSSS population and we now recommend that the Corps further adjust water management actions with a goal of providing at least 90 consecutive dry nesting days between March 1 and July 15, over at least 24,000 acres within and adjacent to CSSS-A, and across at least 40 percent of each of the eastern subpopulations (B-F), to allow for multiple broods during each nesting season in order to stabilize and potentially increase the population.

The second metric, an average annual discontinuous hydroperiod of between 90 and 210 days, which normally occurs outside of the nesting season, is required to maintain suitable marl prairie habitat for the CSSS. If the number of days with surface water is consistently more than 210 days, the habitat will convert to sawgrass. If it is consistently too dry (less than 90 days) woody vegetation encroaches on the habitat and there is an increased risk of fire. Based on data from the NP-205 gauge, CSSS-A has exceeded the 210 day hydroperiod in all but three years since 1992. Therefore, in order to maintain suitable sparrow habitat, the Service recommends that the Corps adjust water management actions with a goal of providing a four year running average discontinuous hydroperiod of 90-210 days over at least 24,000 acres within and adjacent to CSSS-A, and across at least 40 percent of each of the eastern subpopulations (B-F). Habitat changes in CSSS-A, as well as other subpopulations, continue to impact the survival and recovery of the sparrow. CSSS-A averaged only 9 percent of its acreage within the optimal 90-210 day hydroperiod range during the period of 1992 to 2014. The larger and more stable subpopulations B and E, as well as the smaller D and F, on average performed better with 33 to 39 percent of their total available habitat in the target annual hydroperiod range.

As a result of altered hydrology, declining habitat conditions, and other factors, the 3 year running average of the annual rate of population increase (r), a recovery metric for the CSSS, has declined. An r value greater than 0 indicates an increasing population, and less than 0 indicates a declining population. Over the period from 1994 to 2004, the three year running average was greater than 0 in 6 years, and less than 0 in 4 years. However, during the last 10 years (2005-2015), r was only greater than 0 in 2 years, and was less than 0 in 8 years. This is a strong indication of a declining population.

The Corps has determined that the proposed continuation of ERTP "may effect" the Everglade snail kite and its designated critical habitat, the wood stork, and the CSSS and its critical habitat. After reviewing the current status of the Everglade snail kite and its designated critical habitat, the status of the wood stork, the status of CSSS and its critical habitat, the environmental baseline for these species within the Action Area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the Everglade snail kite and wood stork, and is not likely to destroy or adversely modify Everglade snail kite designated critical habitat or CSSS designated critical habitat.

After reviewing the current status of the CSSS, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is likely to jeopardize the CSSS. The Service finds that the survival of the CSSS is at risk and concludes that continuing the ERTP, as proposed, will appreciably reduce the likelihood of both the survival and recovery of the CSSS by reducing its reproduction, numbers, and distribution. Therefore, continuing the ERTP as proposed would violate section 7(a)(2) of the Act.

When the Service makes a finding of jeopardy or adverse modification, section 7(b)(3)(A) of the Act directs the Service to suggest those reasonable and prudent alternatives that we believe would not violate section 7(a)(2) and that the Federal agency could take in implementing the agency action. This BO describes a single RPA that the Service has developed in discussions with the Corps to comply with section 7(a)(2) of the Act. We do not provide additional RPAs, because the recommended RPA is a performance-based approach intended to achieve the habitat outcomes identified that would avoid jeopardy. To the extent we are able at this time, we have specified management actions that we believe will achieve these outcomes, but we must also rely on a commitment to adaptive management, *i.e.*, to revise management actions over time as necessary to achieve the intended outcomes based on monitoring. It is the Corps' decision whether to adopt this RPA or to apply for an exemption from the requirements of section 7(a)(2) under section 7(g).

Should the Corps adopt the RPA, this BO includes an Incidental Take Statement that exempts from the prohibitions under section 9 of the Act the anticipated amount or extent of taking of listed species that is incidental to implementation of the RPA and that is in compliance with the statement’s terms and conditions.

Consultation History

Previous Consultations

This project and related components have an extensive consultation history going back to the mid-1980s. A complete history of the previous consultations can be found in Appendix A of this document.

Consultation History for ERTP-2016

In a letter dated November 17, 2014, the Corps provided their annual assessment for Water Year (WY) 2014 and reinitiated formal ESA consultation on ERTP as a result of an exceedance of an Incidental Take threshold in the ERTP BO. Specifically, the annual CSSS population estimate fell below 2,915 sparrows which is the long term average from 2001 to 2009 minus one standard deviation. The actual estimated CSSS population was 2,720. In their letter, the Corps explained that they had completed a post-assessment of water management operations for 2013-2014 and concluded that their operations did not contribute to the transition from groundwater to surface water at gauge NP-205 during WY 2013 or WY 2014; and therefore, they did not believe that the observed decline in the CSSS population could be attributed to their actions.

The Service responded to the Corps reinitiation request with a letter dated December 12, 2014, in which the Service thanked the Corps for their decision to discuss the problems and opportunities associated with current ERTP operations while also looking forward to the next iteration of ERTP. The letter went on to acknowledge that naturally occurring weather events were likely a primary cause for not meeting many of the hydrologic thresholds for CSSS in 2013; however, it also alerted the Corps that further modifications to the current water management regime are needed for the survival and recovery of the CSSS. The Service also provided our report pertaining to the Corps' annual report entitled *Review of U.S. Army Corps of Engineers Everglades Restoration Transition Plan Annual Assessment Report: Water Year 2013, Initial Analysis of Water Year 2014*. This review suggested that the Corps should focus on new and improved operational flexibility, including investigating operations at the S-332 and S-12 structures with the goal of improving sparrow habitat and population numbers, so that CSSS and other threatened and endangered species can better handle the transition into full Everglades restoration.

As a result of the correspondence exchange listed above, staff members and management from the Corps and Service convened a meeting at the Corps' office in Jacksonville on December 18, 2014. The purpose of the meeting was to discuss the problems and opportunities surrounding future water management and the conservation of threatened and endangered species in the Greater Everglades. The Service expressed its opinion that a more rapid effort to restore the natural hydrology in western SRS, a major tenant of the Comprehensive Everglades Restoration Plan (CERP) and Modified Water Deliveries (MWD) projects, would be the most practical and cost effective method to begin the recovery of CSSS. The Corps offered to look for more operational flexibility in the current operating system but stated, as it did in 2010, that at the present time there are limited opportunities within the existing C&SF Project infrastructure to realize anticipated Everglades restoration benefits such as reconnecting WCA-3A, WCA-3B, and Northeast Shark River Slough (NESRS).

By letter dated January 26, 2015, the Corps responded to the Service and indicated that it would convene a technical team to review reasonable and prudent measures for protection of the endangered Cape Sable seaside sparrow as part of the reinitiation. The Corps also stated that in order to recover this subspecies, they believe that a Comprehensive Conservation Plan needs to be developed that includes: 1) identification of vital rates that have the greatest effect on CSSS population growth; 2) identification and reduction of the most significant factors negatively affecting population growth; 3) identification of potential future habitat for this subspecies in light of predicted flows associated with Everglades restoration projects and projected sea level rise; 4) identification of habitat and population enhancement techniques to enhance resiliency; and 5) exploration of translocation and captive breeding; among other items. The Service had already initiated a plan to achieve many of these items in its Department of the Interior (DOI) Memorandum of Understanding (MOU) completed after consultation on the Central Everglades Planning Project (CEPP). The MOU has been signed by the various DOI agencies, including the Service, ENP, and the U.S. Geological Survey (USGS), and projects are already underway to address many of these concerns.

On February 19, 2015, staff members and management from the Corps and Service convened a follow-up strategy meeting at the Corps' office in Jacksonville to discuss potential actions that could be taken for the benefit of the CSSS.

By letter dated March 3, 2015, the Service reiterated what had been stated at previous meetings on December 18, 2014, and February 19, 2015, and in previous correspondence, that the most critical issue facing the sparrow today is altered hydrology in what was once the largest and most productive subpopulation, CSSS-A. The letter also stated that the minimum requirements, in place since 2001, are not sufficient to allow population growth in the depressed subpopulations of the CSSS (CSSS-A, C, D, and F). For example, the Service's analysis indicated that for CSSS-A, where there has been too much water, at least 90 consecutive dry nesting days and an average annual discontinuous hydroperiod of 90-210 days should be the targets for hydrologic restoration in the western marl prairies. The hydrologic restoration of the western marl prairies is expected to be an important result of the CERP and should not be delayed any longer. The Service suggested ways that the infrastructure and operational strategy could be changed to benefit the sparrow while maintaining the other requirements of the C&SF Project.

In a technical team meeting held on March 26, 2015, the Corps provided an initial analysis of extended closures for the S-12A and S-12B structures as proposed by the Service. While this analysis indicated only a modest rise in WCA-3A water levels (0.1 – 0.2 feet on average) as a result of 30-day extensions of the S-12A and S-12B closures, the Corps stated that a deviation expected to result in increased WCA-3A water levels prior to completing the BAMM analysis would require approval from higher levels due to the concerns about levee safety and other risks in WCA-3A and stated that they would pursue alternative actions toward restoring western Shark River Slough hydrology. The Corps would continue with Increments 0, 1, 2 and 3 of the field test of the S-356 and G-3273 constraint relaxation, create a spreadsheet to track the reduction in

S-12 discharges as a result of the field test operations and help plan the investigation of water flow on the western side of CSSS-A, and search for increased operational flexibility for beneficial water flows when the regulation schedule in WCA-3A allowed for it (*e.g.*, not in Zone A). The Corps stated that should the Service request a change in operations for the benefit of the sparrow (*e.g.*, any deviation to the S-12 closures), the incremental test would need to be postponed until NEPA could be reopened and analysis completed as to the effects a deviation would have on the test.

During a telephone conference on April 29, 2015, the Corps provided additional analysis of extended S-12A and B closures proposed by the Service. The Corps indicated that the only time in which it could keep the S-12A and B structures closed longer than their specified opening date (July 15) was if stages in WCA-3A were lower than Zone A of the regulation schedule (10.25 feet NGVD). The Service noted that keeping the structures closed longer when water levels are that low in WCA-3A does not provide additional protection to the sparrow or its habitat since water levels are already low and there would be limited flow, if any, through the structures. It is at times when the regulation schedule is calling for releases through S-12A and B that continued closures will help nesting sparrows and reduce average annual hydroperiods.

On June 10, 2015, staff and management from the Service, DOI, ENP, and the Corps met to discuss the reinitiation of ERTP and the path forward. Among the issues discussed were the incidental take exceedances which occurred during ERTP, finding operational flexibility within the current system, water quality issues resulting from moving more water into eastern ENP, column-2 operations and their evolution through IOP, current water conditions for the G-3273 test, and the tracking spreadsheet for flows that could be diverted from the S-12 structures.

On June 15, 2015, a meeting between the Corps, DOI, South Florida Water management District (SFWMD) and the Service occurred in order to brief and gather input from the local sponsor, the SFWMD. SFWMD staff had previously indicated that it was possible to shift more flow east and were also interested in management scenarios involving C-111 flows and operation of the S-332 Detention Areas.

In correspondence dated June 16, 2015, the Corps requested the Service's concurrence on a list of threatened and endangered species and their critical habitat that may be affected within the ERTP-2016 project area.

A multiagency coordination meeting for ERTP-2016 was held on June 17, 2015, at the SFWMD Headquarters in West Palm Beach, Florida. Representatives from government agencies and public stakeholders presented current information, issues and goals/objectives for future water operations in the ERTP-2016 project area.

On July 16, 2015, the Service provided the Corps a list of federally threatened and endangered species along with candidate species potentially occurring within the project area.

On July 22, 2015, the Corps submitted a Supplemental Biological Assessment (BA) for their proposed ERTP-2016 actions which are intended to, "maximize operational flexibilities to better manage for Cape Sable seaside sparrow…" and with the "goals of the reasonable and prudent measures to enhance protection for Cape Sable seaside sparrow."

By e-mail dated September 15, 2015, the Service provided the Corps with substantial comments to its BA, however, the Corps declined to revise the document. The Service did not submit a request for additional information because the deadline for a new BO (January 1, 2016) was approaching and the BA was sufficient to initiate consultation.

A telephone conference was convened on September 16, 2015, between staff and managers of the Corps and Service to discuss the BO. Specifically, the Corps was interested in knowing what the Service was planning to include as Terms and Conditions in its BO. The Service could not provide details as its analysis of the proposed actions and their potential effects to threatened and endangered species was not yet complete. The Corps reiterated what they had stated earlier in the BA, that monitoring for the snail kite would only be done in the ERTP-2016 action area (WCA-3A and surrounding areas) and that they no longer wanted to fund range-wide snail kite monitoring under ERTP-2016.

By e-mail on October 21, 2015, the Service requested that the Corps provide additional detail on the proposed changes to the Action Area (Figure 4 of the Corps' BA). The Corps responded the same day with a brief response.

On December 3, 2015, the Corps and Service held a conference call to discuss the potential extension of the expiration date of the current BO in order to complete the analysis, delivery of the draft BO, and potential jeopardy determination.

On December 10, 2015, the Corps and Service met to discuss the BO.

On December 15, 2015, the Service, FWC and others met to discuss the ERTP-2016 consultation.

On December 18, 2015, the Service, ENP, DOI, and the Corps held a teleconference to have initial discussions on the ERTP-2016 BO Reasonable and Prudent Alternative.

By e-mail on December 23, 2015, the Service provided the Corps with a draft table of Reasonable and Prudent Alternatives (RPAs) in preparation for a January 12, 2016 meeting.

By letter dated December 31, 2015, the Service provided an extension to the 2010 ERTP Biological Opinion so that additional coordination could be completed. The BO expiration date was set to April 1, 2016.

On January 4, 2016, the Service and ENP held a teleconference to discuss the development of the ERTP-2016 BO Reasonable and Prudent Alternatives.

By e-mail on January 7, 2016, the Service provided the Corps with draft Terms and Conditions for the Everglade snail kite and wood stork. The Corps responded on January 15, 2016, with a request to have a meeting to discuss the proposed terms and conditions for the snail kite. A teleconference was held on January 20 to discuss the terms and conditions for these species.

On January 12, 2016, the Corps, Service, DOI, and ENP representatives held an ERTP-2016 Reinitiation Technical Team meeting to provide an overview of Corps water management opportunities and considerations, status of Cape Sable seaside sparrow needs, and the DOI Memorandum of Understanding, to review the Service Reasonable and Prudent Alternatives (RPA) table, and brainstorm other RPAs or RPA efficiencies. The Udall Foundation, an independent entity of the executive branch of the U.S. Government, was also in attendance and was retained to provide facilitation for future discussions.

On January 20, 2016, the Corps and Service met to discuss the impact of ERTP-2016 on the Everglades snail kite and the associated terms and conditions for the ERTP-2016 BO.

On January 25, 2016, the Corps and Service met to discuss status of the ERTP-2016 BO.

On January 28, 2016, the Corps and Service had a teleconference to discuss the upcoming technical team discussion and develop the methodology to track the RPA development.

On February 1, 2016, the Corps, Service, and NPS (ENP and BCNP) met with Shannon Estenoz, Director, Office of Everglades Restoration Initiatives. The purpose of the meeting was to have a technical team discussion to formulate reasonable and prudent alternatives for protection of the endangered Cape Sable seaside sparrow (CSSS) compatible with Comprehensive Everglades Restoration Program objectives.

On February 8, 2016, the Service, ENP, and Corps held an ERTP-2016 Steering Committee teleconference to review the purpose, structure, and function of the steering committee.

On February 11, 2016, the Corps, ENP, BCNP and Service had a teleconference to discuss needs for the L-28 Canal study.

On February 12, 2016, the Corps, Service, ENP, SFWMD, FWC, DEP, and Tribal representatives met to discuss the current high water event. Discussion focused around real estate issues and acquiring flowage easements.

On February 16, 2016, the Service, Corps, and ENP held an ERTP-2016 Steering Committee meeting to submit agency response to actions in the Reasonable and Prudent Alternative (RPA) table including whether the action is technically feasible, the benefit to Cape Sable seaside sparrow subpopulation A, and whether the action is within agency authority.

On February 17, 2016, as part of the Temporary Emergency Deviation to address record rainfall associated with El Nino, the S-333 was opened to full capacity from 600 cfs to 1,210 cfs by the Corps.

On February 17, 2016, the Corps, ENP and Service had a teleconference to discuss ERTP-2016 reporting and the next steps to completing the BO.

On February 18, 2016, the Corps, ENP, and Service had a teleconference to discuss what data is available for ERTP and how that data should be analyzed.

On February 19, 2016, the Service and USGS held a teleconference to discuss USGS participation in data analysis for the ERTP-2016 BO.

On February 22, 2016, the Corps, SFWMD, Service, NPS (ENP and BCNP) and USGS held a Cape Sable seaside sparrow ERTP-2016 modeling working group kickoff meeting, to assist in developing spatially explicit decision analysis tools and supporting simulation models to support Cape Sable seaside sparrow resource management in project-level evaluation in relation to changes in project-level and regional water management, habitat management, and climate.

On February 24, 2016, the Corps, ENP and Service held a teleconference to discuss the BO schedule and refinement process for the RPA and BO development.

On February 25, 2016, the Corps, ENP and Service had a meeting to discuss involvement of non-federal partners in the development of the BO and RPAs, and how to best utilize the Udall Foundation in the ERTP-2016 dispute resolution process.

On February 26, 2016, the Service, ENP, USGS, and Corps held an ERTP-2016 technical discussion teleconference to review additional results from USGS sparrow analysis, get updates on USGS internal review to support providing results for use in the ERTP-2016 BO, and share brief updates on the S-12 options.

On February 29, 2016, the Corps, Service and ENP met to discuss the current progress on the ERTP-2016 BO and the Temporary Emergency Deviation actions.

On March 1, 2016, the Corps sent a letter to the Service requesting consultation under ESA for the Temporary Emergency Deviation to alleviate high water levels in WCA-3A, and also requesting an extension to the ERTP Biological Opinion.

On March 1, 2016, the Corps, ENP and Service held a teleconference to discuss the Temporary Emergency Deviation and the extension of the BO expiration date.

On March 3, 2016, the Corps, ENP and Service held a teleconference to discuss adaptive protocols and review the RPA progress.

On March 4, 2016, the Corps, Service, ENP, BCNP, and USGS held a teleconference to discuss ecological modelling results and the USGS analysis of those results. The Corps also presented their adaptive management protocol.

On March 7, 2016, the Corps, Service and ENP met to discuss the BO schedule, RPA development, and outreach process.

On March 8, 2016, the Service invited the Corps, FWC, SFWMD, and researchers to a meeting to discuss the Everglades snail kite status. One point of discussion centered on the Corps reduction in monitoring for the species as proposed under the ERTP-2016.

On March 8, 2016, the Service and Corps held a teleconference to discuss the ERTP-2016 Reasonable and Prudent Alternative (RPA) table.

On March 10, 2016, the Corps, ENP and Service held a teleconference to discuss the status of the RPA development.

On March 14, 2016, the Corps, SFWMD, ENP, and Service met to discuss the Temporary Emergency Deviation for the L-28 Canal and S-344 structure.

On March 16, 2016, the Service, Corps and ENP held a teleconference to discuss the Temporary Emergency Deviations, L-28 actions, and the revised BO schedule.

On March 17, 2016, the Corps, SFWMD, ENP, BCNP, and Service had a teleconference to discuss the L-28/S-344 Temporary Emergency Deviation.

On March 18, 2016, the Corps and Service had a teleconference to discuss the emergency consultation associated with the Temporary Emergency Deviation.

On March 18, 2016, The Service, Corps, ENP, DOI, USGS, Tribes, FDEP, FDACS, and DEP held a webinar updating the status of ESA consultation on ERTP-2016.

On March 28, 2016, the Corps, SFWMD, ENP, BCNP, and Service had a teleconference to discuss the L-28/S-344 Temporary Emergency Deviation.

On March 30, 2016, the Corps, Service and ENP held a teleconference to discuss the Temporary Emergency Deviation, actions associated with the L-28 Canal, and plan for the upcoming stakeholder meeting.

On March 31, 2016, the Service sent a letter to the Corps in response to the Corps March 1, 2016, letter requesting consultation under ESA for the temporary emergency deviation to alleviate high water levels in WCA-3A, and also requesting an extension to the ERTP Biological Opinion. The Service by this letter initiated consultation on the temporary emergency deviation, and agreed that an extension of the ERTP BO was warranted and extended the ERTP BO to July 15, 2016.

On April 1, 2016, the Corps, Service and ENP held a teleconference to discuss the upcoming stakeholder meeting and develop a plan for communicating with Tribal representatives.

On April 5, 2016, the Corps, Service and ENP had a teleconference to discuss multi-agency tribal coordination, coordination with the media, status of the consultation, and how to include non-federal stakeholders in the consultation process.

On April 7, 2016, the Service, Corps, ENP, DOI, USGS, FDEP, FDACS, DEP, FWC and representatives of the Miccosukee Tribe of Indians of Florida attended a webinar. The purpose of this meeting was to discuss the status of ESA consultation on ERTP-2016 and to understand how operational flexibility may be used to limit potential effects on the Cape Sable seaside sparrow. Additionally monitoring, proposed conservation measures, and the draft scope of work for the
L-28 study were discussed.

On April 8, 2016, the Corps, Service and ENP held a teleconference to discuss upcoming model efforts, BO timeline and development of the RPAs.

On April 11, 2016, the Corps notified the Service that the Corps was requesting another Temporary Emergency Deviation. This deviation, at the S-344 structure, was to alleviate high water levels in WCA-3A. The S-344 structure has a mandated closure during the CSSS breeding period along with the S-343A/B and S-12A/B. This deviation opened the S-344 immediately instead of waiting until the opening date of July 15. Along with this deviation, the Governor of Florida declared an emergency order that provided funds for the District to repair six plugs in the L-28 canal. These plugs were intended to prevent flow south in the L-28 from the S-344 into the S-12A area and ultimately into the western marl prairie.

On April 12, 2016, the Corps, Service and ENP held a teleconference to discuss the SFWMD scope of work for ERTP-2016 modelling, USGS CSSS report, impacts of the S-12s on CSSS and review the BO schedule.

On April 14, 2016, the Service and the Corps held a teleconference to conduct a technical review of the emergency deviation.

On April 20, 2016, the Corps, ENP, DOI and Service held a teleconference to discuss the Temporary Emergency Deviation.

On April 21, 2016, Bob Sobzack of BCNP discovered that the S-344 was already discharging water into the L-28 due to the failure of the culvert. It was determined, upon inspection by the SFWMD, that the damaged S-344 structure was flowing 40 cfs.

On April 25, 2016, the Corps, Service and ENP held a teleconference to discuss the SFWMD model kickoff, providing support for USGS to evaluate the model output, BO timeline and development of the RPAs.

On April 25, 2016, the Corps, Service and ENP held a teleconference to discuss progress on the completion of the draft BO and RPAs.

On April 29, 2016, the Service, ENP, USGS, SFWMD, and Corps held a webinar to discuss what outputs may be desired and/or reasonably expected from the modeling effort, and how those outputs may be used to support the development of measures and actions in the ERTP-2016 BO.

On May 2, 2016, the Service, ENP, USGS, SFWMD, and Corps held a webinar to discuss the initial ERTP-2016 /Cape Sable seaside sparrow modeling outcomes.

On May 4, 2016, a coordination meeting was held between the Corps, SFWMD and the Service regarding L-28 canal plug progress prior to fully opening the S-344 structure. Current operations, water levels at monitoring gauges, rainfall received and projected rainfall were also discussed.

On May 11, 2016, a coordination meeting was held between the Corps, SFWMD and the Service regarding L-28 canal plug progress prior to fully opening the S-344 structure. Current operations, water levels at monitoring gauges, rainfall received and projected rainfall were also discussed.

On May 13, 2016, the Service, ENP, USGS, SFWMD, and Corps met to discuss the expected outcomes for Modeling Round 1 and Existing Conditions Baseline scenarios.

On May 16, 2016, the Corps, Service and ENP held a teleconference to discuss delivery of portions of the draft BO to the Corps for their review, updates on model results and to plan for the upcoming multi-agency meeting.

On May 17, 2016, the Service, ENP, USGS, SFWMD, and Corps attended a webinar to discuss the results of the Modeling Round 1 and iModel runs. These runs included five scenarios for the S-12 and associated structures closures (R1A, R1B, R1C, R1D, and R1E) and the revised Existing Conditions Base (ECB16)

On May 18, 2016, a coordination meeting was held between the Corps, SFWMD and the Service regarding L-28 canal plug progress prior to fully opening the S-344 structure. Current operations, water levels at monitoring gauges, rainfall received and projected rainfall were also discussed.

On May 19, 2016, the Service received a telephone notification from the SFWMD that all L-28 canal plug repairs were complete and that the S-344 was opened fully with a discharge rate of 150 cfs.

On May 20, 2016, the Service, ENP, USGS, SFWMD, and Corps attended a webinar to discuss Modeling Round 1 and iModel results and formulation of Round 2 modeling scenarios.

On May 24, 2016, the Corps, Service and ENP met to discuss the RPA and schedule for draft deliverables for the Corps review.

On May 25, 2016, the ENP, USGS, and Service held a webinar to further discuss ERTP-2016 modeling.

On May 25, 2016, a coordination meeting was held between the Corps, District and FWS regarding the S-344 structure, current operations, water levels at monitoring gauges, rainfall received and projected rainfall.

On May 26, 2016, the Corps conducted a periodic scientist call to provide conditions and expected water management operations during the temporary emergency deviation.

On May 27, 2016, the Service, ENP, USGS, SFWMD, and Corps held a webinar to discuss the ecological post processing of the RSM model and preliminary modeling results from the USGS.

On May 31, 2016, the Service, ENP, USGS, SFWMD, and Corps held a webinar to discuss model results from Round 2, clarify the intent of the next phase of modeling, provide overarching analysis of modeling results to date, provide technical recommendations, and determine areas of agreement and/or disagreement. The Round 2 modelling included four additional scenarios (R2F, R2G, R2H, and R2I) for the S-12 and associated structures closures.

On May 31, 2016, a coordination meeting was held between the Corps, District and the Service regarding the S-344 structure, current operations, water levels at monitoring gauges, rainfall received and projected rainfall.

On June 6, 2016, the Corps, Service and ENP had a webinar to discuss the upcoming stakeholder meeting and review current model results.

On June 7, 2016, the Corps, Service, Tribes, EPA, NPS, ENP, USGS, FDEP, FWC, Miami-Dade County, FDACS, SFWMD, and the public met to discuss the status of ESA consultation on ERTP-2016. Additionally, the purpose of the meeting was to understand how operational flexibility within the MWD Incremental operations may be used to reduce potential effects on the Cape Sable seaside sparrow and to share basic information.

On June 8, 2016, a coordination meeting was held between the Corps, District and the Service regarding the S-344 structure, current operations, water levels at monitoring gauges, rainfall received and projected rainfall.

On June 9, 2016, the Corps, Service, ENP, and District also held a conference call for the District modeling team to provide an overview on the I-Model/R2I results and an overview of the Round 3 RSM-GL results for Increment 1 and Increment 2 potential future conditions.

On June 14, 2016, the Service, ENP, USGS, SFWMD, and Corps met to discuss model results from Round 3. Round 3 consisted of additional variations of model runs R2I, R1B, and R2H. These additional runs included increased stages in the L-28 canal relative to the incremental field tests that the Corps is conducting. The scenarios included in this set of model results were INCR1B, INCR1H, INCR2B, INCR2H, INCR2B2, and INCR2H2.

On June 15, 2016, a coordination meeting was held between the Corps, District and the Service regarding the S-344 structure, current operations, water levels at monitoring gauges, rainfall received and projected rainfall.

On June 16, 2016, the Corps conducted a periodic scientist call to provide conditions and expected water management operations during the temporary emergency deviation.

On June 16, 2016, the Corps, ENP and Service leadership held a conference call to discuss modelling results and resolution of the RPA concerns.

On June 24, 2016, the Corps and Service met to resolve remaining issues and disagreements in the Cape Sable seaside sparrow reasonable and prudent alternative in the draft BO.

On June 27, 2016, the Service and Corps held a conference call to remaining issues and disagreements in the Cape Sable seaside sparrow reasonable and prudent alternative in the draft BO and to determine areas of agreement and what issues needed elevation.

On June 29, 2016, a coordination meeting was held between the Corps, District and the service regarding the S-344 structure, current operations, water levels at monitoring gauges, rainfall received and projected rainfall.

On July 1, 2016, the Corps and Service held a conference call to continue to resolve remaining issues and disagreements in the Cape Sable seaside sparrow reasonable and prudent alternative in the draft BO.

On July 6, 2016, the Corps and Service held a conference call to continue to resolve remaining issues and disagreements in the Cape Sable seaside sparrow reasonable and prudent alternative in the draft BO.

On July 7, 2016, the Corps conducted a periodic scientist call to provide conditions and expected water management operations during the temporary emergency deviation.

On July 7, 2016, there was a conference call between the Corps and Service to go over the Corps' comments to the draft RPA section of the Biological Opinion.

On July 8, 2016, there was a conference call between the Corps and Service to go over the Corps' comments to the draft Biological Opinion.

On July 12, 2016, the Service provided an extension to the 2010 ERTP Biological Opinion so that additional coordination could be completed. The BO expiration date was set to July 22, 2016. Additionally, the Service provided a letter requesting that the S-12A and S-12B and associated structures remain closed beyond July 15 until we have determined that most CSSS breeding activity had ceased. The request was for a 2-week delay in opening the structures.

On July 13, 2016, a coordination meeting was held between the Corps, District and the Service regarding the S-344 structure, current operations, water levels at monitoring gauges, rainfall received and projected rainfall.

On July 18, 2016, the Corps and Service held a conference call to discuss the Corps' concerns about language included in the BO.

On July 19, 2016, the Corps and Service held a conference call to discuss the Corps' concerns about language included in the BO.

Concurrence

The Corps determined that the proposed project will have "no effect" on the following species:

Listed species "no effects" determination. E = Endangered; T = Threatened

Common Name	Scientific Name	Status	No Effect
Mammals			
West Indian manatee	*Trichechus manatus*	E, CH	X
Birds			
Red-cockaded woodpecker	*Picoides borealis*	E	X
Roseate tern	*Sterna dougallii dougallii*	T	X
Reptiles			
Green sea turtle	*Chelonia mydas*	E	X
Hawksbill sea turtle	*Eretmochelys imbricate*	E	X
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	X
Leatherback sea turtle	*Dermochelys coriacea*	E	X
Loggerhead sea turtle	*Caretta caretta*	T	X
Fish			
Smalltooth sawfish	*Pristia pectinata*	E	X
Invertebrates			
Miami blue butterfly	*Cyclargus (=hemiargus) thomasi bethunebakeri*	E	X
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	X
Bartram's hairstreak butterfly	*Strymon acis bartrami*	E, CH	X
Florida leafwing butterfly	*(Anaea troglodyta floridalis)*	E, CH	X
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T	X
Plants			
Okeechobee gourd	*Cucurbita okeechobeensis* spp. *okeechobeenis*	E	X
Cape Sable thoroughwort	*Chromolaena frustrata*	E	X
Florida bristle fern	*Trichomanes punctatum ssp. floridanum*	E	X

The Corps provided the following analyses to support their determination of "no effect" for the species listed above.

West Indian Manatee

The Florida manatee is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers and springs of Florida. The Florida manatee, *Trichechus manatus*, was listed as endangered throughout its range for both the Florida and Antillean subspecies (*T. manatus latirostris* and *T. manatus manatus*) in 1967 (32 FR 4061) and received federal protection with the passage of the ESA in 1973. Because Florida manatee was designated as an endangered species prior to enactment of ESA, there was no formal listing package identifying threats to the species, as required by section 4(a)(1) of the Act.

Florida manatees can be found throughout the southeastern United States; however, within this region, they are at the northern limit of their range (Lefebvre et al. 2000). Because they are a subtropical species with little tolerance for cold, they remain near warm water sites in peninsular Florida during the winter. During periods of intense cold, Florida manatees will remain at these sites and will tend to congregate in warm springs and outfall canals associated with electric generation facilities (Florida Power and Light 1989). During warm interludes, Florida manatees move throughout the coastal waters, estuaries, bays, and rivers of both coasts of Florida and are usually found in small groups. During warmer months, Florida manatees may disperse great distances. Florida manatees have been sighted as far north as Massachusetts and as far west as Texas and in all states in between (Rathbun et al. 1983; Fertl et al. 2005). Warm weather sightings are most common in Florida and coastal Georgia. They will once again return to warmer waters when the water temperature is too cold (Hartman 1979; Stith et al. 2006). Florida manatees live in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. It can be found in both clear and muddy water. Water depths of at least three to seven feet (one to two meters) are preferred and flats and shallows are avoided unless adjacent to deeper water.

Over the past centuries, the principal sources of Florida manatee mortality have been opportunistic hunting by man and deaths associated with unusually cold winters. As of March 2010, the FWC reported 431 Florida manatee deaths, more than the total number of deaths in reported 2009, related to the prolonged cold water conditions in the winter of 2009-2010. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. The largest single mortality factor is collision with boats and barges. Florida manatees also are killed in flood gates and canal locks, by entanglement or ingestion of fishing gear, and through loss of habitat and pollution (Florida Power and Light 1989).

Florida manatees have been observed in conveyance canals within the Action Area, specifically in the lower C-111 Canal just downstream of S-197; and adjacent nearshore seagrass beds throughout Florida Bay including all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee and Buttonwood sounds. The extensive acreages of seagrass beds in the bay provide important feeding areas for Florida manatees. Florida manatees also depend upon canals as a source of freshwater and resting sites. It is highly likely that Florida manatees also depend on the deep canals as a cold-weather refuge. The relatively deep waters of the canals respond more slowly to temperature fluctuations at the air/water interface than the shallow bay waters. Thus, the canal waters remain warmer than open bay waters during the passage of winter cold fronts. Figure 42 illustrates canals that Florida manatees have access to within ERTP-2016 Action Area.

As ERTP-2016 does not include any construction features and is solely an operational plan to redistribute the amount and timing of water releases from WCA-3A to ENP, the Corps has determined that the continued implementation of ERTP-2016 and associated reasonable and prudent measures will have no effect on Florida manatee.

The Service concurs with this determination.

West Indian Manatee Critical Habitat

Critical habitat for the Florida manatee was designated in 1976 (50 CFR 17.95). This was one of the first designations of critical habitat for an endangered species and the first for an endangered marine mammal. Critical habitat for any species is described as the specific area within the geographic area occupied by the species (at the time it is listed under the provisions of section 4 of the ESA) on which are found those physical or biological features (*i.e.*, constituent elements) essential to the conservation of the species and which may require special management considerations or protection. No specific primary or secondary constituent elements were included in the critical habitat designation. However, researchers agree that essential habitat features for the Florida manatee include 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).

The Florida manatee's critical habitat includes all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee and Buttonwood sounds between Key Largo, Monroe County, and the mainland of Miami-Dade County (Figure 43). Another component of designated critical habitat is defined as "Biscayne Bay, and all adjoining and connected lakes, rivers, canals and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County." (CFR 50 Parts 1 to 199; 10-01-00). The ERTP-2016 Action Area includes primarily Card, Barnes, Blackwater, Little Blackwater and Manatee sounds.

The main Action Area lies north of designated critical habitat for the Florida manatee. Changes to the amount and timing of water releases from WCA-3A to ENP under ERTP-2016 are not expected to increase flow volumes in the downstream estuaries or within the boundaries of designated Florida manatee critical habitat. It is highly unlikely that the action will affect nearshore salinity levels or seagrass biomass. Consequently, impacts to Florida manatee foraging areas are not expected. Therefore, the Corps has determined that continued implementation of ERTP and associated reasonable and prudent measures will have no effect on designated critical habitat for Florida manatee.

The Service concurs with this determination.

Red-cockaded Woodpecker

The red-cockaded woodpecker is identified by its conspicuous white cheek patch, black and white cross-barred back, black cap and nape, white breast and flanks with black spots. In addition, the males have a small bright red spot on each side of the black cap. The bird is approximately 8½ inches in length with a wingspan of 14½ inches. The female is somewhat smaller and resembles the male in coloration, with the exception of a red streak alongside the black cap. The female is approximately 7⅜ inches with a wingspan of 13¼ inches (Service 1999).

Red-cockaded woodpeckers are a social species and live in groups with a breeding pair and up to four helpers, generally male offspring from the previous year. Approximately 200 acres of mature pine forests are necessary to support each group's nesting and foraging habitat needs. Juvenile females will leave the group prior to the breeding season and establish a breeding pair within a solitary male group. Breeding pairs are monogamous and will raise a single brood each breeding season. Three to four small white eggs will be laid within the roost cavity and incubated by members of the group for a period of ten to twelve days. Chicks are also fed by members of the group and remain within the roost cavity for approximately 26 days. Insects, including ants, caterpillars, moths, grasshoppers, spiders and beetle larvae comprise approximately 85 percent of their diet. The remainder of their diet consists of wild grapes, cherries, poison ivy berries, blueberries and nuts such as pecans (Service 1999).

Red-cockaded woodpeckers live in mature pine forests, specifically those with longleaf pines averaging 80 to 120 years old and loblolly pines averaging 70 to 100 years old. Destruction of its preferred long-leaf pine habitat by humans or disease (pines afflicted by fungus or redring rot) resulted in the woodpecker becoming listed as endangered in 1970. The current range is from eastern Texas to the southeastern United States and southern Florida. Historically, red-cockaded woodpeckers were found abundantly from Texas to New Jersey and as far inland as Tennessee.

The red-cockaded woodpecker is an upland species and shown in the Florida Natural Areas Inventory as not inhabiting any area in Miami-Dade or Broward Counties. Therefore, the Corps has determined that there would be no effect on this species from the continued implementation of ERTP-2016 and associated reasonable and prudent measures. The Service concurs with this determination.

Roseate Tern

A coastal species, the roseate tern nests on open sandy beaches away from potential predation and human disturbance. This species feeds in nearshore surf on small schooling fishes. In southern Florida, the roseate tern's main nesting areas are located in the Florida Keys and the Dry Tortugas where they nest on isolated islands, rubble islets, and dredge spoils. Although suitable foraging opportunities exist along the shoreline within the project area, the proposed project is not likely to affect their feeding habits or nesting areas. Therefore, the Corps determined that the continued implementation of ERTP-2016 will have "no effect" on the roseate tern. The Service concurs with the Corps' determination.

Sea Turtles and Smalltooth Sawfish

Federally-listed marine species under the purview of the National Marine Fisheries Service (NOAA Fisheries) include the green sea turtle and its designated critical habitat, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle and its designated critical habitat, loggerhead sea turtle, and the smalltooth sawfish and its designated critical habitat. The Corps has coordinated with the NOAA Fisheries pertaining to potential action effects on listed species under their purview (March 2010).

Miami blue butterfly

The Miami blue is a small butterfly endemic to Florida. The Miami blue has a forewing length of 10 to 13 millimeters. Males and females are both bright blue dorsally, but females have an orange eyespot near their hind wing. Both sexes have a gray underside with four black spots. The Miami blue butterfly occurs at the edges of tropical hardwood hammocks, beachside scrub, and occasionally in rockland pine forests. Larval host plants include the seed pods of nickerbeans (*Caesalpinia* spp.), blackbeards (*Pithecellobium* spp.), and balloon vine (*Cardiospermum halicababum*), a non-native species. Adults feed on the nectar of Spanish needles (*Bidens pilosa*), cat tongue (*Melanthera aspera*), and other weedy flowers near disturbed hammocks. Primarily a south Florida coastal species, the Miami blue's historic distribution ranged as far north as Hillsborough County on the Gulf Coast and Volusia County on the Atlantic Coast and extended south to the Florida Keys and the Dry Tortugas (Service 2012a). The butterfly was thought to be extinct following Hurricane Andrew in 1992, but was observed in November 1999 at Bahia Honda State Park in the Florida Keys. More than 329 surveys conducted at locations in mainland Florida and the Keys have failed to detect other colonies of this species. The Corps has determined that continued implementation of ERTP-2016 would have no effect on Miami blue Butterfly. The Service concurs with this determination.

Schaus Swallowtail Butterfly

The Schaus swallowtail butterfly is a large dark brown and yellow butterfly originally listed as an endangered species because of population declines caused by the destruction of its tropical hardwood hammock habitat, mosquito control practices, and over-harvesting by collectors. Schaus swallowtail butterfly distribution is strictly limited to tropical hardwood hammock habitat and the remaining occurrence of this type of habitat is concentrated in the insular portions of Miami-Dade and Monroe Counties from Elliott Key in BNP and associated smaller Keys to central Key Largo (Service 1999). It is estimated that remaining suitable habitat for this species is 43 percent of the historical suitable habitat in BNP and 17 percent for north Key Largo. The primary threats at the time of listing and through the present time are habitat loss, overutilization (illegal collecting), and pesticides used in mosquito abatement (Service 2008b). Due to the lack of preferred subtropical hardwood hammock habitat in the Action Area, the Corps determined that the continued implementation of ERTP-2016 will have "no effect" on the Schaus swallowtail butterfly. The Service concurs with this determination.

Bartram's hairstreak butterfly and its designated critical habitat and Florida leafwing butterfly and its designated critical habitat

The Bartram's hairstreak is a small butterfly approximately 1 inch (25 millimeters) in length with a forewing length of 0.4 to 0.5 inches (10 to 12.5 mm). Bartram's hairstreak is easily recognized by broad white bands with a black edge that can be seen when the wings are closed. This species does not exhibit sexual or seasonal dimorphism. The Florida leafwing is a medium-sized butterfly approximately 2.75 to 3 inches (76 to 78 millimeters) in length. The open wing surface color is red to red-brown, the closed wing is gray to tan, with a tapered outline, cryptically looking like a dead leaf when the butterfly is at rest. The Florida leafwing exhibits sexual dimorphism, with females being slightly larger and with darker coloring along the wing margins than the males.

The Service published a final rule in the Federal Register on August 12, 2014 and a correction on August 19, 2014, listing both Bartram's hairstreak butterfly and Florida leafwing butterfly as endangered and identifying critical habitat for each species. Populations of both species have declined throughout their historic range and their distributions are now extremely limited. While the exact cause of the declines is uncertain, potential factors for the declines may include destruction of pine rockland habitat, introduction of exotic plant and insect species, fire suppression or exclusion, use of insecticides for mosquito control, and collecting (NPS 2014).

These species were listed as endangered in part due to their specificity on a single host plant, pineland croton (*Croton linearis*) and loss of associated habitat. Both species occur only in pine rockland, specifically in pine rockland communities that contain their mutual and sole host plant, pineland croton (Service 2015a). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, pine rocklands are a fire-maintained community and require regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). Fire suppression, fragmentation, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rocklands, prompting the listing of these species under the ESA (Service 1999).

Within the Action Area, pine rocklands occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. These species have the potential to occur within the rocky glades surrounding the Frog Pond Area. Under the current consultation for ERTP-2016, there are no proposed changes to the operations of this seepage reservoir, and as such, any effect on pine rocklands from action implementation is expected to be insignificant. Therefore, the Corps has determined that continued implementation of ERTP-2016 will have no effect on Bartram's hairstreak butterfly and its designated critical habitat or Florida leafwing butterfly and its designated critical habitat. The Service concurs with these determinations.

Stock Island Tree Snail

The arboreal Stock Island tree snail inhabits hardwood hammocks consisting of tropical trees and shrubs such as gumbo limbo (*Bursera simaruba*), mahogany (*Swietenia mahagoni*), black ironwood also called leadwood (*Krugiodendron ferreum*), poisonwood also known as Florida poison tree or hog gum (*Metopium toxiferum*), red mulberry (*Morus rubra*) and wild coffee (*Colubrina arborescens*), among others. Population declines, habitat destruction and modification, pesticide use and over-collecting led to the federal listing of this species as threatened in 1978 (Service 1999).

The historical distribution of the Stock Island tree snail was thought to be limited to hardwood hammocks on Stock Island and Key West and possibly in other lower Keys hammocks. Recently, the range of this species has been artificially extended through the actions of collectors who have introduced it to Key Largo and the southernmost reaches of the mainland. At present, this snail occupies six sites outside of its historic range including ENP and BCNP. The current population trend is unknown and the species status is uncertain as the threats to the species at the time of listing (habitat loss due to development, pesticides, vegetation trimming, overutilization for collecting purposes, and non-native predators) are continuing at the same level today (Service 2009b). However, due to the limited amount of preferred subtropical hardwood hammock habitat in the project area, the Corps determined that the continued implementation of ERTP-2016 will have "no effect" on the Stock Island tree snail. The Service concurs with this determination.

Okeechobee Gourd

The Okeechobee gourd is a climbing annual or perennial vine possessing heart to kidney shaped leaf blades. The cream-colored flowers are bell-shaped and the light green gourd is globular or slightly oblong.

The Okeechobee gourd was locally common in the extensive pond apple forest that once grew south of Lake Okeechobee (Small 1922, 1930). Historically, the Okeechobee gourd was found on the southern shore of Lake Okeechobee in Palm Beach County and in the Everglades. Currently, this species is limited to two disjunct populations, one along the St. Johns River in Volusia, Seminole and Lake Counties in northern Florida and a second around the shoreline of Lake Okeechobee in south Florida (Service 1999). The conversion of the pond apple-forested swamps and marshes for agricultural purposes as well as water-level regulation within Lake Okeechobee have been the principal causes of the reduction in both the range and number of the Okeechobee gourd. The current species status is declining mainly due to recent threats to the habitat in the Lake Okeechobee population (Service 2009c). The Okeechobee gourd is not known to inhabit any area in Miami-Dade or Broward Counties (FNAI 2008). Therefore, the Corps determined that the continued implementation of ERTP-2016 will have no effect on this species. The Service concurs with this determination.

Cape Sable thoroughwort

The Cape Sable thoroughwort is endemic to south Florida and is a flowering perennial herb that is 8-40 inches tall. The Cape Sable thoroughwort was historically known from Monroe County, both on the Florida mainland and the Florida Keys, and in Miami-Dade County along Florida Bay. The current range of the species includes areas in ENP and five islands in the Florida Keys.

It occurs throughout coastal rock barrens and berms and sunny edges of rockland hammock. The decline of the species is primarily the result of habitat loss from commercial and residential development, sea level rise, storms, competition from non-native plants, predation by non-native herbivores, and wildfires. Critical habitat for the species occurs in nine separate units across approximately 10,968 acres of Miami-Dade and Monroe Counties. The nine units are: 1) ENP, 2) Key Largo, 3) Upper Matecumbe Key, 4) Lignumvitae Key, 5) Lower Matecumbe Key, 6) Long Key, 7) Big Pine Key, 8) Big Munson Island, and 9) Boca Grande Key. Seven of the nine units are currently occupied by the plant. Continued implementation of ERTP-2016 is not expected to affect coastal rock barrens; therefore, the Corps has determined that the action will have no effect on this species or its designated critical habitat. The Service concurs with this determination.

Florida bristle fern

The Florida bristle fern is very small in size and superficially resembles other bryophytes, such as mosses and liverworts, making it difficult to observe in its natural habitat. It is mat forming, has no roots, and contains trichomes (hairlike/bristelike outgrowth) on the tip of the fern. In southeastern North America, *Trichomanes* spp. are considered rare because of their delicate nature and requirements for deeply sheltered habitats with almost continuous high moisture and humidity (Farrar 1993b, Zotz and Büche 2000). In Florida, the subspecies is only known to occur in Miami-Dade and Sumter Counties. In Miami-Dade County, the Florida bristle-fern is generally epiphytic (a plant that grows non-parasitically upon another plant) or epipetric (growing on rocks), typically growing in rocky outcrops of rockland hammocks, in oolitic limestone solution holes, and, occasionally, on tree roots in limestone surrounded areas (Philips 1940, Nauman 1986, Whitney et al. 2004, Possley 2013f, Van der Heiden and Johnson 2014). In Miami-Dade, the historical range of the subspecies extended from Royal Palm Hammock (now in ENP) at its southern limit, northeast to Snapper Creek Hammock, which is located in R. Hardy Matheson Preserve. The four populations that constitute the Miami Dade County metapopulation are located in urban preserves managed by the County's Environmentally Endangered Lands Program and include Castellow Hammock Park, Hattie Bauer Hammock, Fuchs Hammock Preserve, and Meissner Hammock. Factors affecting the subspecies include habitat modification and destruction caused by human population growth and development and hydrologic alterations. Within the Action Area, rockland hammocks occur on the Miami Rock Ridge and extend into the Everglades. Systematic surveys completed in ENP over the years have not been able to find the Florida bristle fern (79 FR 61148; October 9, 2014). Although potentially suitable habitat exists within the Action Area, the Corps has determined that continued implementation of ERTP-2016 will have no effect on the subspecies. The Service concurs with this determination.

The Corps also determined that the continued implementation of ERTP-2016 "may affect, but is not likely to adversely affect" the following species or their designated critical habitats:

Listed species "may affect, not likely to adversely affect" determination.
E = Endangered; T = Threatened; SA = Similarity of Appearance; CH = Critical Habitat.

Common Name	Scientific Name	Status	May Affect, Not Likely to Adversely Affect
Mammals			
Florida panther	*Puma concolor coryi*	E	X
Florida bonneted bat	*Eumops floridanus*	E	X
Reptiles			
American alligator	*Alligator mississippiensis*	T, SA	X
American crocodile	*Crocodylus acutus*	T, CH	X
Eastern indigo snake	*Drymarchon corais couperi*	T	X
Plants			
Deltoid spurge	*Chamaesyce deltoidea spp. deltoidea*	E	X
Garber's spurge	*Chamaesyce garberi*	T	X
Small's milkpea	*Galactia smallii*	E	X
Tiny polygala	*Polygala smallii*	E	X

Florida Panther

The Florida panther, also known as cougar, mountain lion, puma and catamount, was once the most widely distributed mammal (other than humans) in North and South America, but it is now virtually exterminated in the eastern United States. Habitat loss has driven the subspecies known as the Florida panther into a small area, where the few remaining animals are highly inbred, causing such genetic flaws as heart defects and sterility. Recently, closely related panthers from Texas were released in Florida and are successfully breeding with the Florida panthers. Increased genetic variation and protection of habitat may save the subspecies.

One of 30 cougar subspecies, Florida panther is tawny brown on the back and pale gray underneath, with white flecks on the head, neck and shoulder. Male panthers weigh up to 130 pounds and females reach 70 pounds. Preferred habitat consists of cypress swamps, pine and hardwood hammock forests. The main diet of the Florida panther consists of whitetailed deer, sometimes wild hog, rabbit, raccoon, armadillo and birds. Present population estimations range from 80 to 100 individuals. Florida panthers are solitary, territorial, and often travel at night. Males have a home range of up to 400 square miles and females about 50 to 100 square miles. Female panthers reach sexual maturity at about three years of age. Mating season is December through February. Gestation lasts about 90 days and females bear two to six kittens. Juvenile panthers stay with their mother for about two years. Females do not mate again until their young have dispersed. The main survival threats to the Florida panther include habitat loss due to human development and population growth, collision with vehicles, parasites, feline distemper, feline alicivirus (an upper respiratory infection), and other diseases.

Florida panthers presently inhabit lands in ENP adjacent to the Southern Glades, and radio tracking studies have shown that they venture into the Southern Glades on occasion during post-breeding dispersion. Reference is made to the revised Panther Key and Panther Focus Area Map for use in determining effects to the Florida panther. ERTP-2016 has the potential to affect both the Primary and Secondary Zones for Florida panther habitat (Figure 44). Florida panthers presently inhabit lands in ENP adjacent to the Southern Glades and radio tracking studies have shown that they venture into the Southern Glades on occasion during post-breeding dispersion. Since potentially suitable habitat occurs within the Action Area, increased water deliveries to ENP could affect Florida panther habitat. However, as lands within ERTP-2016 Action Area become restored to their more historic natural values, the concomitant improved prey base would result in greater use by the Florida panther utilizing these areas. In addition, by lowering WCA-3A Regulation Schedule more upland habitat may become available within the Florida panther's primary and secondary zone, directly benefiting the species. Based on this information, and the fact that Florida panther is a wide ranging species with the majority of sightings west of the Action Area, the Corps has determined that continued implementation of ERTP and associated reasonable and prudent measures outlined within the Supplemental Biological Assessment may affect, but is not likely to adversely affect the Florida panther. The Service concurs with this determination.

Florida bonneted bat

The Florida bonneted bat is Florida's largest bat, weighing approximately 1.1 to 2.0 ounces, with a 19 to 21 inch wingspan and a body length of 5.1 to 6.5 inches. The species has dark brown fur and large broad ears that join together and slant forward over the eyes. Relatively little is known regarding the ecology and habitat requirements of this species. In general, bats will forage over ponds, streams and wetlands and require roosting habitat for daytime roosting, protection from predators and rearing of young (Marks and Marks 2008). Florida bonneted bats roost in tree cavities, rocky outcrops and dead palm fronds. In residential communities, the bats roost in Spanish tile roofs, but have also been found in attics, rock or brick chimneys and fireplaces of old buildings (NatureServe 2009). Colonies are small, with the largest reported as just a few dozen individuals. The bat is a nocturnal insectivore and relies upon echolocation to navigate and detect prey. Females give birth to a single pup from June through September (Timm and Genoways 2004); however limited data suggests that a female may undergo a second birthing season possibly in January or February.

The Florida bonneted bat is Florida's only endemic bat. The range of this species is limited to southern Florida, although this species was encountered in 2008 in two locations within the Kissimmee River Wildlife Management Area north of Lake Okeechobee. Florida bonneted bat has only been documented in 12 locations within Florida, including Coral Gables, Homestead, Naples, Everglades City and North Fort Myers. Seven of the locations are under public ownership with Florida bonneted bat found in discrete and specific areas within BCNP, Fakahatchee Strand Preserve State Park, Kissimmee River Wildlife Management Area, Babcock Ranch and Fred C. Babcock and Cecil M. Webb Wildlife Management Area.

The Service has defined consultation areas and focal areas for the Florida bonneted bat in south Florida (Figure 45). The ERTP-2016 Action Area falls within a defined focal area. At present, no active, natural roost sites are known within the Action Area that will be impacted by the action. Until recently, all active, known roosts were from bat houses. In October, 2014, an active roost site was monitored in Avon Park Air Force Range, and in July 2015 another active roost site was discovered on the Florida Panther NWR, both in pine snags. Impacts to potential roost sites are not anticipated under continued implementation of ERTP. Based on the 2013 Florida Bonneted Bat FWS Consultation guidelines, the Corps has determined that the action may affect, but is not likely to adversely affect, this species. The Service concurs with this determination.

American Crocodile (and American Alligator by similarity of appearance only)

The American alligator is a large, carnivorous reptile related to crocodiles that inhabits freshwater lakes, ponds, marshes, sloughs, swamps, canals and, occasionally, brackish waters throughout the southeastern United States. A distinguishing characteristic from the American crocodile, a close relative, is that only the upper teeth are visible with the mouth closed, while both the upper and lower teeth are visible on the American crocodile.

The alligator was first classified as endangered throughout its range in 1967 due to concern over poorly regulated or unregulated harvests. Subsequently, the alligator recovered rapidly in many parts of its range due to response to Federal and State protection, enabling the Service to reclassify the alligator from endangered to threatened due to similarity of appearance in Florida, reflecting complete recovery (June 20, 1985; 50 FR 25672).

The crocodile was listed under the Act on September 25, 1975 (Service 1999). In 1985, alligators were down-listed and reclassified in Florida from “threatened” to a status of “threatened due to similarity of appearance” because of its similarity to the endangered American crocodile. Therefore, an analysis of effects to the American alligator is not required under the Act. In 2007, the crocodile was similarly down-listed and reclassified in Florida from a status of “endangered” to “threatened” since the population has more than doubled and its distribution has expanded (50 CFR Part 17).

The current distribution of the American crocodile in the United States is limited to Miami-Dade and Monroe Counties with occasional occurrence in Collier, Lee, and Palm Beach Counties in southern Florida. The American crocodile is found primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks, and inland swamps (Kushlan and Mazzotti 1989). During the non-nesting season, crocodiles are found primarily in the fresh and brackish waters in inland swamps, creeks, and bays. During the breeding and nesting season (spring and summer) adults use the exposed shorelines of Florida Bay. Natural nesting habitat includes sites with sandy shorelines or raised marl creek banks adjacent to deep water. Crocodiles also nest on elevated man-made structures such as canal berms, spoil banks, and other places where fill has been introduced (Service 1999).

American crocodiles are known to exist throughout the Action Area within ponds, canals, and shorelines (Cherkiss 1999). The cooling canals of Florida Power and Light’s Turkey Point Power Plant, which occur within the action boundary, support the most successful crocodile nesting population in south Florida (Mazzotti et al. 2002). These cooling canals offer adequate nesting habitat because they satisfy the crocodile’s two primary nesting requirements–suitable substrate above the normal high-water level and adjacent deep-water refugia. While crocodiles prefer sandy substrates, they will often utilize canal spoil banks (Kushlan and Mazzotti 1989). Canal banks and levees associated with major canals in the project area are generally suitable for nest sites, and berms associated with old agricultural secondary canals may also be suitable for nesting. Overall, the crocodile population in Florida has more than doubled in size since it was originally listed to an estimated 1,400 to 2,000 individuals and appears to be compensating for the identified threats to the species (Service 2006d).

Although the American crocodile has a high probability of occurrence within the Action Area due to the presence of available habitat, no adverse impacts to the American crocodile are expected as a result of this action. The original listing rule cited the restriction of freshwater flow to the Everglades because of increasing human development as a potential threat to the American crocodile (Service 2006d).

Consequently, as more freshwater is delivered to ENP, overland sheetflow may potentially increase or enhance suitable habitat for juvenile crocodiles. The area potentially most directly affected by ERTP-2016 represents only a small portion of the species habitat throughout its range, therefore, the Corps has determined that the action "may affect, but is not likely to adversely affect" the American crocodile. The Service concurs with this determination.

American Crocodile Critical Habitat

Critical habitat for the American crocodile was originally designated in 1979 (50 CFR 17.95) (Figure 46). However, this critical habitat designation was revised for Florida in October 2000 (50 CFR Parts 1 to 199). The 2000 revision for Florida includes all land and water within the following boundary: From the easternmost tip of Turkey Point on the southern coast of Biscayne Bay; southeastward along a straight line to Christmas Point on the southernmost tip of Elliott Key; southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Angelfish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key; to the westernmost tip of Middle Cape; then northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; and eastward along a straight line to the northernmost point of Nine-Mile Pond in ENP; and then finally northeastward along a straight line to the point of beginning at Turkey Point.

Anticipated benefits of the proposed action may include improving the quality, quantity, timing, and distribution of water delivered to ENP. This could potentially aid in restoring more natural salinities in estuarine habitats where critical habitat has been designated for the American crocodile. It is likely that the effects of distributing overland sheetflow through ENP wetlands rather than point-source freshwater discharges into Florida Bay will be beneficial on tidal wetlands and help stabilize nearshore salinity concentrations within crocodile critical habitat, but these effects are expected to be minimal for ERTP-2016. The proposed action has the possibility of enhancing crocodile habitat within the Action Area, however, the degree to which this may occur is uncertain. The Corps therefore determined that this action "may affect, but is not likely to adversely affect" critical habitat for the American crocodile. The Service concurs with this determination.

Eastern Indigo Snake

The Eastern indigo snake is the largest native non-venomous snake in North America. It is an isolated subspecies occurring in southeastern Georgia and throughout peninsular Florida. The Eastern indigo snake prefers drier habitats, but may be found in a variety of habitats from xeric sandhills, to cabbage palm hammocks, to hydric hardwood hammocks (Schaefer and Junkin 1999). Eastern indigo snakes need relatively large areas of undeveloped land to maintain their population. The main reason for its decline is habitat loss due to development. Further, as habitats become fragmented by roads, Eastern indigo snakes become increasingly vulnerable to highway mortality as they travel through their large territories (Schaefer and Junkin 1999).

In south Florida, the Eastern indigo snake is thought to be widely distributed. Given their preference for upland habitats, Eastern indigo snakes are not commonly found in great numbers in the wetland complexes of the Everglades region, even though they are found in pinelands, tropical hardwood hammocks, and mangrove forests in extreme south Florida (Duellman and Schwartz 1958; Steiner et al. 1983).

Since Eastern indigo snakes occur primarily in upland areas their presence in the Action Area is somewhat limited. The hydrologic effects of the continued implementation of ERTP are expected to benefit existing or historic wetlands and are not expected to have significant effects on the upland habitats preferred by this species. Therefore, the Corps has determined that continued implementation of ERTP and associated reasonable and prudent measures may affect, but are not likely to adversely affect, Eastern indigo snake. The Service concurs with this determination.

Deltoid Spurge, Garber's Spurge, Small's Milkpea, and Tiny Polygala

Pine rocklands are the primary habitat for deltoid spurge, Garber's spurge, Small's milkpea and tiny polygala. This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, pine rocklands are a fire-maintained community and require regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). Fire suppression, fragmentation, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rocklands, prompting the listing of these species under the ESA (Service 1999).

Within the Action Area, pine rocklands occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. These listed plant species have the potential to occur within the rocky glades surrounding the Frog Pond Detention Area. Under ERTP-2016, there are no proposed changes to the operations of this seepage reservoir, and as such, any effect on pine rocklands from action implementation is expected to be insignificant. Therefore, the Corps has determined that continued implementation of ERTP and associated reasonable and prudent alternative measures may affect, but are not likely to adversely affect, deltoid spurge, Garber's spurge, Small's milkpea or tiny polygala. The Service concurs with these determinations.

Because the Service concurs that the above listed species and their designated critical habitats would not be adversely affected by the proposed action, these species or their designated critical habitat will not be considered further in this Biological Opinion.

Bald Eagle

The bald eagle is no longer a listed species under the Act (71 FR 8238). Therefore, there is no requirement under the Act to consult on potential impacts to the bald eagle. However, the bald eagle continues to be protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Analysis of 2016 Temporary Emergency Deviations

The Corps initiated a Temporary Emergency Deviation to Alleviate High Water Levels in Water Conservation Area 3A (WCA-3A) during February 2016. The intent of this deviation was to address high-water concerns related to the record El Nino rainfall. The Service responded to the Corps' request for the Temporary Emergency Deviation by letter dated February 11, 2016. On March 1, 2016, the Service received a letter from the Corps requesting emergency ESA consultation (informal consultation) for the Temporary Emergency Deviation to Alleviate High Water Levels in Water Conservation Area 3A (WCA-3A). The Service responded by sending a letter of support for the deviation and current species list which began the consultation process.

In keeping with standard protocol, the Service stated it would wait until the emergency action was complete to offer its official regulatory response and concurrence if appropriate. In the interim, the Service requested that the Corps consider including many of the actions taken during this most recent emergency action into their analysis for ERTP-2016. The following is provided in accordance with the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.). The water management operating criteria relating to the action affects an area within the C&SF Project located in south Florida and includes WCA-3, ENP, and adjacent areas and is coincident with the ERTP-2016 project area. Features of the action are located in Broward and Miami-Dade Counties. Since the first temporary emergency deviation recently ended (May 11, 2016) and the Recovery period for it has been extended through the completion of NEPA for the Increment 1 Plus, and a second temporary emergency deviation is still in place, we cannot fully evaluate the effects to listed species at this time.

The strong El Nino during the 2016 dry season contributed to unseasonably high water levels in WCA-3A. Therefore, the Corps initiated a temporary deviation for 90 days to increase the operational constraint level in the L-29 Borrow Canal from an elevation of 7.5 feet to 8.5 feet NGVD, as measured between structure S-333 and S-334. Other necessary changes to the Central and Southern Florida Project (C&SF) operations were also required to support this change. Operational changes associated with the L-29 Borrow Canal stage constraint have been previously proposed by various entities during past WCA-3A high-water events and are goals of the ongoing Modified Water Delivery and CERP projects. Until the recent completion of the 1-mile Bridge and associated road-raising, L-29 stage levels have been constrained to 7.5-ft NGVD to avoid adverse impacts to the Tamiami Trail road bed. USACE and SFWMD secured temporary flowage authorization agreements with affected parties along the L-29 Canal prior to water levels being raised. SFWMD also provided mitigation measures that restricted flows from coming into the vendors' properties along the L-29 Canal. In addition, due to ongoing construction contracts for the MWD and C-111 South Dade projects, the SFWMD also constructed temporary features to alleviate high water levels in the southwest portion of the Las Palmas community (also referred to as the 8.5 Square Mile Area). The operational changes to the L-29 Canal stage allowed for the full discharge capacity of 1,300 cfs through S-333 beginning on February 17 to help mediate the high water in WCA-3A. The other operational changes mediated concerns with increased seepage from ENP and increased S-334 deliveries into the South Dade Conveyance System.

On March 1, 2016, the Corps issued a Supplemental Environmental Assessment (EA) to evaluate the effects of the Temporary Emergency Deviation on threatened and endangered species within the project area. Based on a regional-scale hydrologic sensitivity analysis conducted by the South Florida Water Management District using their South Florida Water management Model (SFWMM), the Corps determined that the temporary deviation may affect but was not likely to adversely affect, the Florida bonneted bat, Cape Sable seaside sparrow (CSSS), Everglade snail kite and wood stork along with other invertebrate and plant species. The Service has not received the Corps' after-action report on the emergency deviation but offers the following analysis as it relates to the performance of the emergency deviation and its effects on threatened and endangered species.

There are several actions which the Corps, in conjunction with the District and other partners, implemented that have not been available or utilized during prior high-water emergencies which may be beneficial to CSSS in the future. These include utilizing more water storage capacity in WCA-3B while installing temporary pumps and the S-155 structures to evacuate excess water, and most importantly raising the operational stage limit in the L-29 Canal to up to 8.5-ft NGVD. Raising this stage allows a significant increase in discharge from WCA-3A into the historic flow path of Northeast Shark River Slough (NESRS) and has been a main objective of Modified Water Deliveries and other CERP projects for well over a decade. The Service is an advocate for restoring water flow eastward into the historic flow path; however, timing of flows through this part of the system is a concern and should be watched closely moving forward. Moving large volumes of water through this region during the dry season, while sometimes unavoidable, is not characteristic of historic conditions and is largely detrimental to species and their habitat in this area. This is a reminder of how critical CERP is to restoring natural flows through the system with natural timing. CERP's construction timeline should be accelerated to the extent practicable.

The emergency action plan worked as well as expected within southern WCA-3A as it helped water levels recede to 10.8 feet NGVD by March 14th. In addition, there was a notable lack of rainfall that assisted to bring the water levels down. Although included in the 2012 WCP, the opening of the S-12A structure, intended to prevent overtopping, is one action taken by the

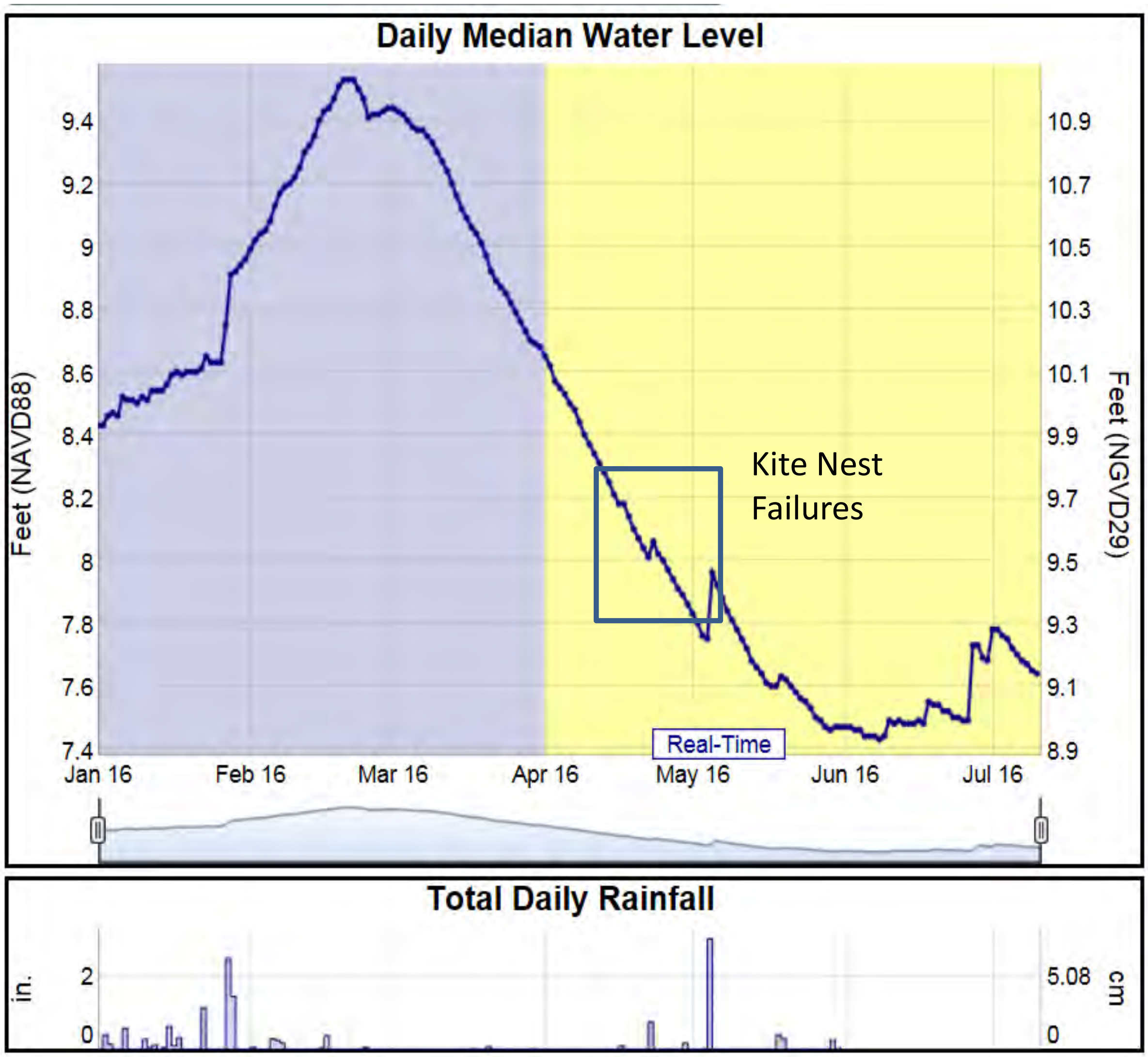
Corps that deeply concerned the Service. In its EA, the Corps specifically states that the ERTP closure periods of the S-12A, S-12B, S-343A, S-343B and S-344 structures, designed for protection of CSSS-A, would remain in place throughout the deviation. They go on to state that the emergency deviation would actually benefit CSSS-A by moving water to the east that would normally go through the S-12A/B structures. Despite the intent to keep these protections in place, the S-12A gates were opened on February 22 to allow the equivalent amount of water that would have otherwise been released by overtopping and were closed on March 10. Uncontrolled overtopping of the structure could have resulted in risk to the integrity of the structure. While the effect of opening this structure was negligible on water levels in WCA-3A, the impact to CSSS-A was noticeable and resulted in a reversal of water levels and elimination of available nesting habitat two weeks into the sparrow nesting season as a result of an additional 4 inches of water across the western marl prairie south of S-12A. Due to this impact, the Service requested an analysis and explanation regarding the threshold at which S-12A must be opened to avoid overtopping and the stage at which the S-12A could be closed once the overtopping risk was reduced.

Similarly, the eastern subpopulations of the CSSS were also negatively affected by the unseasonable rainfall and diversion of water by the emergency actions as it flooded the banks of the Northeast Shark River Slough which are normally dry or receding in the dry season. This is an unavoidable impact during the occasional high water emergencies experienced in a compartmentalized system, but serves as a stark reminder of why we are implementing CERP and the urgency with which we need to go forward with its implementation. One of the reasons the Service would like to see the L-29 stage constraint raised to 8.5-ft NGVD permanently as part of ERTP-2016 is so that future emergency actions can be taken much sooner in an effort to prevent moving high volumes of water late in the dry season and avoiding overtopping of the S-12A/B structures. Although the Corps determined that the emergency action was not likely to adversely affect the CSSS, it is apparent that negative effects were observed for the CSSS. However, it is difficult to separate the effects of the emergency action from the effects of the record rainfall events, which highlights the difficulty of water management in this area and the need to proceed rapidly with the implementation of CERP.

Another consequence of having to implement a rapid drawdown of WCA-3A is its negative effect on snail kite reproduction. Snail kites exhibit higher nest success rates when water levels recede slowly, not more than 1 foot, throughout the nesting period. The figure below shows that water levels at the W-2 gauge in southwestern WCA-3A receded at a much quicker rate of 2 feet in just 2 months. This rapid recession rate may have facilitated predation at 11 of the 13 documented snail kite nests in southwestern WCA-3A. The Corps' concluding paragraph of the effects of their action on the snail kite states:

> "A potential increase in hydroperiods within NESRS may provide an overall net benefit for Everglade snail kites and apple snail habitat. Increases in volume into NESRS provide an opportunity for improved vegetation, including expansion of sloughs and wet prairies, and contraction of sawgrass ridges. However, due to the short duration of the temporary emergency deviation, significant vegetation changes are not anticipated.

Based on this information and the limited duration of the Federal Action, the Corps has determined that implementation of the Federal Action may affect, but is not likely to adversely affect this species and its designated critical habitat. The Corps will continue to rely upon the Increment 1 monitoring plan and will continue to implement Periodic Scientist Calls as outlined within the 2011 ERTP Final EIS."



Water levels at W-2 in southwestern WCA-3A before and after the emergency deviation.

Although the Corps determined that the emergency action was not likely to adversely affect the snail kite, it is apparent that negative effects occurred. As with the CSSS, it is difficult to separate the effects of the emergency action from the effects of the record rainfall event; i.e., but for the unseasonal rainfall, the rapid recession would not have occurred that likely facilitated the high predation rate of the known kite nests. Again, water management emergencies such as this one highlight the flaws of the current compartmentalized system that is imposed on the Everglades' hydrology.

The Service, Corps and SFWMD continued discussions about ways to alleviate conditions resulting from the El Nino event and on April 10, 2016, the Corps requested a temporary emergency deviation of the S-344 structure to alleviate high water levels in WCA-3A. This structure has a mandated closure during the CSSS breeding period along with the S-343A/B and S-12A/B. Along with this deviation, the Governor of Florida declared an emergency order that provided funds for the District to repair six plugs in the L-28 canal. These plugs were intended to prevent S-344 flow from going south in the L-28 Canal, into the S-12A area and ultimately into the western marl prairie of CSSS-A. The plugs are also there to promote flows from the S-344 into Big Cypress National Preserve. This deviation allowed for the S-344 to open immediately after the plugs were installed instead of waiting until the opening date of July 15.

It was determined by SFWMD staff on April 21, 2016, that the S-344 was already discharging water at an estimated rate of 40 cfs into the L-28 due to corrosion and partial section loss within the culvert. The District completed the repair of the six plugs in the L-28 canal and the S-344 was opened full with a discharge of 150 cfs on May 19, 2016. The structure remains open and is expected to remain open during the remainder of the 2016 wet season. The Service has not yet received a post-action report regarding the effects of the emergency response action. Since the culvert was already allowing water flow for an undetermined period of time, it will be difficult to assess the hydrologic impacts to nearby WCA-3A or downstream CSSS-A. It is reasonable to infer, however, that the action may have provided an incremental contribution to the rapid recession rates which may have negatively impacted snail kite reproduction in southwestern WCA-3A. It is also unclear how the rehabilitated plugs in the L-28 borrow canal affected adjacent water levels and whether water was successfully sent into the Big Cypress National Preserve. In its correspondence, the Corps determined that the emergency deviation at S-344 may affect, but was not likely to adversely affect the Florida bonneted bat, Cape Sable seaside sparrow, Everglade snail kite, and wood stork. It is still unclear at this time the effects of the emergency response actions on these listed species. The Service requests that the Corps provide an after-action report or other analyses of the specific actions taken during the emergency and their effects on water levels, listed species, and designated critical habitat, so that we may appropriately update the status of the species and apply lessons learned to the next emergency.

BIOLOGICAL OPINION

A Biological Opinion (BO) is the document required under the Endangered Species Act (Act) that states the opinion of the Service as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat (50 CFR §402.02). This BO addresses the effects resulting from the Corps' proposed continued operation of ERTP (the action) to the Cape Sable seaside sparrow (CSSS) and its critical habitat, Everglade snail kite and its critical habitat, and wood stork.

"*Jeopardize the continued existence of*" means 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 the species (50 CFR §402.02).

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

This BO is based on best available science, including information provided in the Corps' Supplemental Biological Assessment, meetings, analysis of modeling output, published peer reviewed research, Corps' annual assessment reports, and additional information. A complete administrative record of this consultation is on file in the South Florida Ecological Services Office, Vero Beach, Florida.

1. DESCRIPTION OF THE PROPOSED ACTION (ERTP-2016)

The Corps' Supplemental Biological Assessment (BA) dated July 24, 2015, for the Everglades Restoration Transition Plan (ERTP-2016) describes the Proposed Action as a continuation of the ERTP adopted in 2012, for which consultation was concluded with a Biological Opinion (BO) dated November 17, 2010. The ERTP defines operations for the constructed features of the Modified Water Deliveries (MWD) and C-111 Projects. A detailed description of the proposed action is found under Section 1.3 Proposed Actions for ERTP-2016.

No changes to the current regulation schedule under ERTP-2016 or its associated infrastructure are proposed at this time; however, the Corps proposes to investigate several changes which may improve water management for the Cape Sable seaside sparrow and other endangered species in the future. Among the proposed investigations is a continued search for and employment of operational flexibilities within the current regulation schedule. Specifically, the Corps will seek additional opportunities to:

- maximize flow into Northeast Shark River Slough;
- extend the closure duration (*i.e.*, open later and/or close earlier) the S-12A, S-12B, S-343A, S-343B, and S-344 structures when conditions allow; and
- increase the use of preemptive releases.

The Corps has agreed to work with the U.S. Fish and Wildlife Service (Service) and the South Florida Water Management District (SFWMD) to optimize operation of the C-111 South Dade Conveyance System (SDCS) and detention areas for the conservation of listed species.

1.1. Action Area

For consultation purposes, the Action Area 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" (50 CFR §402.02). The ERTP-2016 defines operations for the constructed features of the MWD and C-111 Projects. The major project components of the MWD and C-111 Projects are shown in Figure 1 (Figures referenced in this BO are included at the end of the document in section 13).

The primary areas in which these projects directly affect water flows and levels are (listed in north-south order):

- Water Conservation Areas (WCAs) 1, 2 and 3;
- Shark River Slough (SRS);
- 8.5 Square Mile Area (8.5 SMA);
- private and public lands served by the South Dade Conveyance System (SDCS); and
- Taylor Slough.

The dominant project feature addressed in ERTP-2016 is the massive wetland impoundment WCA-3A. How it is managed affects a large area that is hydrologically downstream and mostly to the south of WCA-3A, but may also affect to a lesser degree the adjacent WCAs and other areas that are hydrologically upstream, including Lake Okeechobee. Likewise, ERTP-2016 may affect Big Cypress National Preserve, Biscayne Bay, and Florida Bay through its modification of freshwater flow in south Florida.

The Action Area spans: (a) the entire range of the CSSS; (b) the range of the Everglade snail kite south of and including Lake Okeechobee; and (c) all wood stork nesting colonies that have been active during the past 10 years and are within 18.6 miles of WCA-3 or Everglades National Park (ENP) (Figure 2).

The Action Area is comprised of a series of hydrologically interconnected wetlands that include some of the largest remaining expanses of Everglades marshes and many man-made features, including canals, levees, and artificial impoundments. Water movement through this system is managed with a variety of water control structures and pumps. The man-made infrastructure influences large volumes of water received via rainfall, which varies seasonally and annually, and which establishes the general hydrologic regime for wetlands in southern Florida.

Historically, the entire Action Area was known as the Everglades; a mosaic of sloughs, tree islands, long-hydroperiod marshes, shorter-hydroperiod marl prairies, sawgrass marshes, and coastal mangrove fringe habitats. Much of this land has been converted to urban development; active agriculture composed of fruit tree groves, row and field crops, and plant nurseries; and abandoned agricultural areas that a variety of native and invasive plant species have colonized. It is estimated that less than half of the historic Everglades remains (Corps 1999).

1.2. ERTP Background and Context

Water management and flood control in south Florida is accomplished through an extensive network of canals, levees, pumping stations, and control structures constructed as part of the Central & South Florida (C&SF) Project, including three WCAs. The WCAs store excess water coming from the Everglades Agricultural Area (EAA), other parts of the east coast region, and Lake Okeechobee flood discharges. The WCAs are designed to prevent Everglades floodwaters from inundating the east coast urban areas, provide a water supply for those same areas and ENP, recharge aquifers, reduce seepage, and protect against saltwater intrusion in coastal well-fields.

The regulation schedules for the WCAs and other facilities contain seasonal and monthly guidelines for acceptable water level ranges at a large number of monitoring stations throughout numerous projects and watersheds. The regulation schedules generally prescribe low stages at the beginning of the wet season (late spring) and high stages at the end of the wet season (late fall). These regulation schedules must accommodate various, often apparently conflicting, water management purposes. Although the seasonal distribution of rainfall determines overall water availability in the system, the regulation schedules modify the timing, duration, and magnitude of extreme water levels (both low and high) that would otherwise occur.

The initial Biological Opinion for ERTP was signed on November 17, 2010 (Service 2010). The proposed action authorized by the ERTP BO was the continuation of the IOP and the operations of the IOP structures and impoundments in the C&SF Project for up to 1 year until the ERTP Record of Decision (ROD) could be signed. The continuation of the IOP included the operations of the Modified Water Deliveries (MWD) and C-111 structural features and impoundments of the C&SF Project as described in the Service's 2006 IOP Biological Opinion (Service 2006a). The ERTP operations replaced the IOP after the ROD for ERTP was signed on October 19, 2012.

The purpose of ERTP was to define operations for the constructed features of the MWD and C-111 projects until those projects were fully completed and a Combined Operations Plan (COP) could be implemented. The ERTP actions included modifications of the IOP and the operations of the IOP structures and impoundments in the C&SF Project under the 2002 IOP Alt-7R plan, including operational flexibilities and were intended to improve or maintain hydrological conditions to benefit multiple listed species and other resource values in the project area. The IOP, a Reasonable and Prudent Alternative (RPA) under the Service's 1999 Biological Opinion, was developed to avoid jeopardy to the CSSS while meeting other needs and constraints of the region, including restoration of sheetflow to ENP and maintenance of flood control in adjacent urban areas. ERTP represented a transition between the IOP and implementation of the MWD, C-111, and CERP project features. Completion of these project features is believed necessary to provide suitable conditions for the recovery of multiple listed species including the CSSS, Everglade snail kite, and wood stork within the project area (Sustainable Ecosystems Institute [SEI] 2003, 2007a, 2007b; National Research Council [NRC] 2008, 2010). Under the current

ERTP projected timeline, the Record of Decision for the revised water control plan, COP, is scheduled for completion in 2020. Many other components of Everglades CERP restoration such as those included in the most recent CEPP are not scheduled to be completed until as late as 2030. Considering the current status of the CSSS, the timing of these projects and uncertainty of the schedules gives reason for concern.

Since the implementation of IOP, prolonged high water in WCA-3A has persisted, likely contributing to degradation of tree islands and marsh habitat (Zweig and Kitchens 2008). In addition, the Everglade snail kite range-wide estimated population declined from a high of approximately 3,500 kites in 1999 to an estimated low of approximately 662 kites in 2009 (Cattau et al. 2009). During this time, the snail kite population essentially declined by half from 2000 to 2002 and again from 2006 to 2008, at least in part, due to two severe regional droughts and a tropical storm (Cattau et al. 2009). By 2012, the population estimate had increased to 1,218 birds (Cattau et al. 2012). In 2015, the population estimate was significantly higher (2,127 birds [95 percent CI = 2,000-2,338]) primarily due to stable fledging rates in Lake Okeechobee, an increase in fledging in the Everglades and STAs, and a large amount of successful nesting in a new area (Mary A. Mitigation Bank in Brevard County) (Fletcher et al. 2016).

The overall CSSS population was low at the inception of IOP but was considered stable by researchers through 2009 at approximately 3,000 sparrows (Basier et al. 2008; Boulton et al. 2009; Cassey et al. 2007; Slater et al. 2009; Virzi et al. 2009). However, in four of the last six years (2011, 2013, 2014, and 2016) the population estimates have been below 3,000 sparrows, with the lowest estimates from 2014 when the population was estimated at only 2,710 birds and preliminary estimates for 2016 which estimated the population as 2,416. The populations did increase in 2012 and 2015 with an estimated population of 3,360 and 3,216 sparrows respectively. Overall, the intrinsic rate of increase for the CSSS has been negative 8 of the last 10 years. Recent investigations have expressed concern about the viability of the population and habitat conditions (Virzi and Davis 2013; Slater et al. 2014).

Given the resource concerns at the time, the overall project objective of ERTP was to utilize operational flexibilities in order to improve conditions for the Everglade snail kite, maintain nesting and habitat requirements for the CSSS, and enhance wood stork and native habitats. The ERTP was expected to provide these water management flexibilities by emphasizing an east-to-west distribution of water, while maintaining the C&SF Project purposes (flood control and water supply). The ERTP was intended to cover operations until full implementation of the Combined Operational Plan (COP) in 2013. However, the prerequisite projects (MWD and C-111) required to implement COP have not yet been completed. The Corps' current schedule for COP has the ROD being signed in early 2020. Additionally, ERTP was set to expire on January 1, 2016, and therefore a new biological opinion is required to allow for operations until MWD and other projects are in place and the COP can be implemented. The expiration date of the ERTP Biological Opinion was extended to April 1, 2016, and then to July 15, 2016, to allow for additional coordination and resolution of project concerns with the Corps, and also to determine the effects of emergency water management actions that were implemented due to heavy rainfall which occurred between February and May, 2016.

1.3. Proposed Actions for ERTP-2016

The Action currently proposed in the Corps' BA is the continued implementation of ERTP and associated operational flexibility. Under ERTP-2016, the Corps will continue to employ existing operational flexibility as outlined in the current operational plan to protect CSSS, Everglade snail kites and wood storks. These flexibilities include maximizing flows through the S-12 structures from the east to the west as capacity allows. This means that, based on headwater conditions in WCA-3A and in accordance with the current Regulation Schedule, flows through S-333 and S-12D will be maximized prior to sending flows through S-12C, with S-12B and S-12A being utilized only after S-12D and S-12C flows have been maximized. This flexibility will ensure that regulatory releases from WCA-3A are prioritized to the east to attenuate flows into western SRS where CSSS-A is located. Additionally, when conditions allow, the Corps will delay opening and/or implement early closure of the S-12A, S-12B, S-343A, S-343B, and S-344 structures beyond their current mandated CSSS restriction dates to limit flow into western SRS. The combination of these actions is intended to minimize the potential effects of Corps actions on CSSS-A. This flexibility is also intended to promote more suitable discontinuous hydroperiods within CSSS habitat by reducing flows to CSSS-A and providing an increase in flows into parts of the eastern subpopulations that are overly dry due to drainage by neighboring canals. Additionally, ERTP-2016 includes the provision for preemptive releases. Preemptive releases are used to create storage within WCA-3A when large adjustments to inflow into WCA-3A or large regional rainfall events are forecasted. This flexibility will assist to maintain target stages within WCA-3A and allow for further flexibility in discharges through the S-12 and S-333 structures. The elements of the proposed action are discussed in more detail in the following sections.

1.3.1. Continuation of ERTP

The ERTP plan was previously chosen based upon hydrological modeling of system conditions using the South Florida Water Management Model (SFWMM). Results of the modeling efforts were evaluated in relation to the ERTP Performance Measures (PM) and Ecological Targets (ET) to select the alternative that best met the ERTP objectives, PMs, and ETs. The SFWMM Run 9E1 represented the ERTP Recommended Plan (Corps 2010a) evaluated in the 2010 ERTP BO and implemented after the ROD was signed in 2012. Elements of the plan which have been completed include operational changes to the IOP Interim Regulation Schedule for WCA-3A; water management structures S-12C, S-346 and S-332D; rainfall plan target flows; the installation of ENP Shark Valley Tram Road removable culvert plugs by DOI; and implementation of WCA-3A Periodic Scientist Calls. The WCA-3/South Dade Conveyance System (SDCS) Operational Guidance was formulated to meet the ERTP PMs and ETs developed by the multi-agency team to improve conditions for the snail kite, wood stork and other wading birds, while maintaining a nesting window for the CSSS. ERTP also incorporated the 2006 IOP Final Supplemental Environmental Impact Statement provisions for Pre-Storm, Storm and Storm Recovery Operations for the SDCS as outlined in Appendix A-Annex B of the Corps' October 2010 Biological Assessment.

ERTP represented a paradigm shift from the previous operational plan, IOP. The IOP predominantly consisted of scheduled closure periods on the S-12 structures, specifically S-343A/B, S-334, S-12A, S-12B, and S-12C, to manage primarily for the CSSS (Figure 1). In contrast, ERTP incorporated operational flexibility and adaptive management to manage WCA-3A and northern ENP for the benefit of multiple species, including the endangered snail kite and wood stork as well as the CSSS. ERTP integrated consideration of new information such as current climatological, hydrological, and biological conditions, project-specific PMs, and Periodic Scientist Calls, as well as maintaining scheduled closure periods for the S-12A, S-12B, S-343A/B, and S-344 structures to attempt to meet nesting condition requirements for the CSSS. The sections below describe the elements included in the ERTP in more detail.

1.3.1.1. *WCA-3A Interim Regulation Schedule*

In July 2010, due to stakeholder concerns regarding high water levels in WCA-3A and discharge limitations of the S-12s, the Corps' Jacksonville District Water Resources Engineering Branch conducted a review of the C&SF Part 1 Supplement 33 General Design Memorandum (GDM) (June 1960) and the C&SF Part 1 Supplement 49: Agricultural and Conservation Areas General and Detail Design Memorandum (August 1972). On September 9, 2010, the Corps issued a position statement regarding WCA-3A regulation schedule modifications. Based upon the results of their review, they concluded that a rigorous evaluation of the Standard Project Flood (SPF) conditions within WCA-3A should be conducted (Corps 2010a).

The Corps proposed a two-phase analysis approach that included the identification and assessment of interim water management criteria for WCA-3A, including operational changes proposed and incorporated under ERTP, and a future WCA-3A flood routing hydraulic analysis. Phase 1 of the analysis identified the 1960 WCA-3A 9.5 to 10.5 feet NGVD Regulation Schedule as the required interim water management criteria for WCA-3A Zone A under ERTP to mitigate for the observed effects of discharge limitations of the S-12 structures, while also recommending further consideration of additional opportunities to reduce the duration and frequency of WCA-3A high water events. This change to the WCA-3A Regulation Schedule, which was implemented with ERTP, represented a return to pre-Experimental Program stage levels for Zone A. Other revisions included expansion of Zone D forward to December 31, expansion of Zone E1 backwards to January 1, and considerations for human health and safety (Corps 2010a, Corps 2010b). Similar to the IOP WCA-3A Regulation Schedule, the revised ERTP regulation schedule utilized the 3-gauge average (Sites 63, 64, 65) (3AVG) stage within WCA-3A for operational management. The intent of expanding Zones D and E1 was to achieve the ERTP objective of managing water levels within WCA-3A for the protection of multiple species and their habitats. Through these modifications, the Corps achieved additional operational flexibility compared to the previous WCA-3A Regulation Schedule in making water releases from WCA-3A in order to alleviate high water conditions in WCA-3A.

The Phase 2 WCA-3A flood routing analysis, which includes the Baseline and Modification Model (BAMM), is currently underway and is expected to be completed in September 2017. The intent of the BAMM is to identify and quantify the cumulative changes to design stage and flow conditions within the WCA system (WCA-1, WCA-2, and WCA-3) due to infrastructure and operational changes that have occurred since the originally authorized C&SF design. The BAMM effort includes development of a new regional flood routing model and model simulations of SPF hydraulic routings for each of the WCAs. The BAMM flood routing results will be used by the Corps to conduct comprehensive risk analysis of levees and structures within the WCAs, including hydraulic and hydrological, and geotechnical and structural engineering, if results warrant. The Corps will evaluate any substantial WCA design deficiencies and determine the resulting path forward based on human health and safety and other C&SF project requirements. The BAMM flood routing model will be used with other regional hydrologic modeling tools to evaluate mitigation options, if necessary.

The Corps is not proposing any changes to the WCA-3A Regulation Schedule until the results of the BAMM, including further analysis and quantification of risk to WCA levees and structures, concern for potential effects of additional closure periods on water elevations within WCA-3A, and impacts to human health and safety, are available. The 2010 ERTP Biological Assessment contains the Corps' evaluation of potential effects of WCA-3A Interim Regulation Schedule on listed species within the ERTP Action Area.

1.3.1.2. ***S-12, S-343, S-344, S-346 Structures/Shark Valley Tram Road Culvert Plugs***

Seasonal closures on the S-12A/B/C, S-343A/B, and S-344 structures were included in the IOP in order to meet the 1999 Biological Opinion's RPA to avoid jeopardy for the CSSS. The ERTP maintained the IOP scheduled closure dates on all of these structures with the exception of S-12C. Under the ERTP, the S-12C seasonal closures (February 1 through July 15) were removed.

To compensate for the removal of the S-12C closures, DOI installed inflatable culvert plugs along the Shark Valley Tram Road within ENP. These culvert plugs were intended to help prevent the westward flow of water from S-12C under the Shark Valley Tram Road and help to maintain shorter hydroperiods within the western marl prairies where CSSS-A resides. The Shark Valley Tram Road culvert plugs were purchased, operated and maintained by DOI, but have since been replaced by sand bags. Removal of the S-12C seasonal closure was recommended during the transition to Everglades restoration to better achieve the objective of managing water levels within WCA-3A for the protection of multiple species and their habitats while also providing additional outlet capacity to address high water concerns within WCA-3A especially during periods when the S-333 outlet structure was constrained due to the G-3273 constraint.

Under IOP and ERTP, S-12D did not have any required closure dates. In order to increase conveyance capacity through the S-12 structures, specifically S-12D, into central Shark River Slough, the S-346 structure, a two-barreled corrugated metal pipe structure located in the L-67 Extension borrow canal in ENP immediately south of the Tamiami Trail (U.S. Highway 41), was to be opened whenever S-12D is open and closed when western Shark Slough structures were closed per ERTP seasonal closures.

Additionally, under ERTP the Corps proposed the release of up to 100 cfs from the S-12A for cultural access. These releases may only be requested by the Miccosukee Tribe of Indians when the Tribe is unable to access cultural areas within ENP. This action was evaluated in the 2012 ERTP Amended BO (Service 2012b).

IOP seasonal closure periods of the S-12A, S-12B, S-343A, S-343B and S-344 structures were maintained under implementation of ERTP and throughout the MWD S-356/G-3273 Increment 1 Field Test. At the request of the Service, the Corps performed a preliminary evaluation of four additional closure criteria. Based upon WCA-3A high water concerns identified within the ERTP Final Environmental Impact Statement (FEIS) (Corps 2011a), the potential risk to levee integrity, as well as the fact that BAMM has not yet been completed, the Corps stated that they were unable to implement additional mandated closure periods on S-12A, S-12B, S-343A, S-343B and S-344 that would further reduce outlet capacity from WCA-3A. However, the Corps has stated that they are committed to implementing existing operational flexibility in order to reduce flows through these structures when conditions permit.

1.3.1.3. ***S-332B, S-332C and S-332D Operations***

The 1994 C-111 GRR authorized construction of a series of pump stations and detention areas along the eastern boundary of ENP in order to maintain a hydrologic ridge between ENP and the developed portions of western Miami-Dade County thereby reducing seepage from ENP and rehydrating the marsh wetlands along the ENP boundary. This detention system was constructed as part of the C-111 and MWD projects and was operated under IOP. Prior to construction of the C-111 Project, water was delivered to Taylor Slough by releases through S-174 and into the L-31W canal system. The S-174 structure was decommissioned and subsequently this water was pumped from the L-31W Canal into the remnant headwater wetlands of Taylor Slough via the S-332 pump station. The S-332 pump station was originally designed with a maximum capacity of approximately 165 cubic feet per second (cfs).

Under the Experimental Program, the pump capacity of S-332 was increased, allowing approximately 465 cfs to be point-source discharged directly into the headwater wetlands of Taylor Slough. The 1999 Biological Opinion for the CSSS occurred during the Experimental Program and resulted in termination of the testing phase. The 465 cfs pumped directly into Taylor Slough wetlands was determined to have an adverse effect on CSSS-C habitat while the original 165 cfs was not thought to have an adverse impact. Therefore, the original S-332 pump capacity of 165 cfs was established as the maximum pumping limit under IOP operations during the CSSS breeding season. The S-332 pump is no longer active, having been replaced by the South Dade Conveyance structure S-332D. Additionally the South Dade Conveyance System has added additional pump capacity via the S-332B and S-332C.

Construction of the S-332D pump station and S-332D Detention Area (aka Frog Pond Seepage Reservoir or S-332D Flowway) was completed in 1997 with operations initiated in August 1999 under the Experimental Program Test 7 Phase 1 Emergency Deviation. These features are located along the west side of the C-111 Canal between the S-176 and S-177 structures (Figure 1). The S-332D pump station became operational on August 31, 1999, and the

S-332D Detention Area became operational in June 2002. The S-332D discharges to an adjacent high-head detention cell with an overflow weir and then into the main detention area flowway, ultimately delivering surface water sheetflow into Taylor Slough near the historical location of S-332. Due to seepage losses to the adjacent C-111 Canal, the S-332D Detention Area does not deliver the same volume of water to Taylor Slough as when deliveries were made through S-174 and S-332. Field data from the Experimental Program and data collected in 2008 and 2009 revealed that a significant volume of water pumped into the S-332D Detention Area flowed back (east) to the C-111 Canal as groundwater seepage. The IOP constraint of limiting S-332D discharges to 165 cfs results in considerably less water reaching Taylor Slough or CSSS habitat than when S-174 and S-332 were used to pump directly into the marsh. As a result, under ERTP, pumping at S-332D was increased from 165 to 250 cfs between February 1 and the end of the CSSS nesting season as determined by the Service.

In addition to the current ERTP operations at S-332D, the Corps has stated that they will work collaboratively with Federal and State partners to reassess S-332B, S-332C and S-332D operations as part of the MWD Increment 2 Field Test scheduled to begin later in 2017. The order of S-332B, S-332C and S-332D pumping could be prioritized based on coordination with the Service, SFWMD and ENP. Local rainfall patterns, antecedent conditions and operations will be discussed in real-time to determine pumping prioritization. However, until completion of construction of the C-111 South Dade Project components (*e.g.* Northern Detention Area and connection to MWD 8.5 Square Mile Area [8.5 SMA] detention cell) is complete, the Corps is not proposing any operational changes outside the existing ERTP flexibility.

1.3.1.4. ***Rainfall Plan Target Flows***

Water releases through the S-333 and S-12 structures are part of the Corps' WCA-3A Regulation Schedule and are determined by the Rainfall Based Water Management Plan (Corps 2010b). The Rainfall Based Water Management Plan consists of a rainfall-based delivery formula that specifies the amount of water to be delivered to ENP in weekly volumes through the S-333 and S-12 structures. Currently, the ENP/SRS flow distribution is 55 percent through S-333 into NESRS and 45 percent through the S-12 structures combined (A-D) into ENP west of the L-67 Extension. The current primary obstacle to achieving Everglades restoration continues to be that water releases through S-333 are typically constrained during the wet season due to the trigger stage at G-3273, which is 6.8 ft NGVD under the 2006 IOP. Therefore, when G-3273 is less than 6.8 ft NGVD (typically during the dry season), 55 percent of the Rainfall Plan Target Flow is released into NESRS through S-333. However, when G-3273 is greater than 6.8 ft NGVD (typically during the wet season), the S-333 is closed or the S-334 is used in conjunction with S-333 to pass all or partial S-333 flows south to the SDCS while circumventing NESRS. When S-333 is closed or anytime S-333 flows cannot be matched through S-334 due to G-3273 being greater than 6.8 ft NGVD, the volume of water that could not be delivered through S-333 shifts to the S-12 structures. In this manner, the G-3273 trigger stage limits the volume of water entering NESRS.

Under ERTP-2016, the Corps will continue to use the existing Rainfall Based Water Management Plan within the Water Control Plan (WCP) for the C&SF Project to determine non-regulatory target flows for the S-12 and S-333 structures. However, due to the implementation of the Corps' Interim High Water Criteria for WCA-3A, which lowers Zone A of the current WCA-3A Regulation Schedule for human health and safety concerns (Corps 2010b), S-333 target flows for non-regulatory releases during the dry season (November 1 through May 31) were increased from 55 percent to 80 percent. This increase was expected to help maintain dry season flows into NESRS that would have been reduced as a result of just lowering the WCA-3A Regulation Schedule.

The results of the current MWD Increment 1 Field Test are expected to be used to reduce the current G-3273 constraint, thereby reducing a constraint on S-333 flow, and allowing additional flow into NESRS. Under ERTP-2016, the existing Rainfall Plan of the current WCP for the C&SF Project will continue to be utilized to determine non-regulatory target flows for the S-12 and S-333 structures.

1.3.1.5. *Periodic Scientist Calls*

The purpose of the Periodic Scientist Calls (PSC) are for the Corps to gather input regarding ecological, hydrological, and meteorological conditions from various governmental and Tribal agencies to make future water management decisions. The monitoring and reporting of ecological, hydrological, and meteorological conditions was critical to achieving the ERTP objective of managing WCA-3A water levels and water releases for the protection of multiple endangered species and their sensitive habitats. Regularly scheduled interagency calls in January, May, and October allow the Corps to gather input on desired long-term (annual and/or seasonal) conditions within WCA-3A and ENP. In addition, the WCA-3A PSC occur on an as-needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP. The WCA-3A PSC focus on both the status of individual species (*e.g.*, Everglade snail kite nesting status) and the status of a suite of species and habitat conditions to allow for adaptive management of the system based upon the needs of multiple species and their habitats. Also, the Corps and the Service, along with other interested agencies, meet annually to discuss the previous year's species and habitat monitoring data in order to ensure that this monitoring is capturing the appropriate parameters and to identify any long-term population trends. Under ERTP-2016, the Corps will continue to implement WCA-3A PSC, which will include discussions on the MWD Field Tests and providing real-time assessment of conditions within the Action Area to ensure wildlife recommendations are considered during the water management decision process.

1.3.1.6. *Implementation of Operational Flexibility within ERTP to Protect CSSS*

The Corps has employed operational flexibility within ERTP to include maximizing flows through the S-12 structures from the east to the west as capacity allows. This flexibility is intended to reduce flows into western SRS where CSSS-A resides. In accordance with the WCA-3A Regulation Schedule and the Rainfall Plan, when flows through the S-12 structures are determined necessary, the Corps will prioritize flow through the easternmost S-12D and S-12C structures as capacity allows, in order to minimize flow through the S-12A and S-12B structures.

This prioritization of the S-12 structures assumes that flows through the S-333 structure into NESRS are already at capacity or have reached an associated constraint. S-12 flows will be prioritized as follows:

1) When the WCA-3A Regulation Schedule and Rainfall Plan calls for releases from WCA-3A and S-333 is maximized, additional releases will be made through S-12D first.
2) If additional releases are still required and S-12D has reached its capacity, then S-12C will be utilized.
3) If additional releases are still required and S-333, S-12D and S-12C are at capacity in relation to the headwater stage differential, then S-12B will be utilized for the required release.
4) Finally, if additional releases are still required, and S-333, S-12D, S-12C, and S-12B are at capacity, only then will S-12A be utilized to deliver the required releases.

In this manner, flows are preferentially distributed to the east and flows into western SRS where CSSS-A resides are reduced. It is important to note that releases through the S-12A and S-12B structures are expected to only occur outside their mandated closure periods unless conditions threaten the overtopping of the S-12A/B structures as they did during 2016. Thus S-12B capacity will be utilized between July 15 and December 31 and S-12A will be utilized between July 15 and October 31, as needed.

In addition, when conditions allow (*i.e.*, when the WCA-3A Regulation Schedule is below Zone A), the Corps will delay opening and/or implement early closure of S-12A, S-12B, S-343A, S-343B, and S-344 structures beyond their current restrictions to limit flow into western SRS. This flexibility is intended to minimize the potential effects of Corps actions on CSSS-A. This flexibility is also intended to be used to promote a 90-210 day discontinuous hydroperiod within CSSS habitat. The Corps has drafted guidance to be used with the 2012 Water Control Plan (Table ES-1 from 2011 ERTP FEIS) to more clearly specify how existing operational flexibility will be employed to address CSSS within the ERTP-2016 Action Area. This guidance is located in Appendix D of the Corps' Supplemental Biological Assessment for ERTP-2016.

Following the Corps' reinitiation request of November 17, 2014, the Corps provided an historical overview of flexibility in closure dates of S-12A, S-12B, S-343A, S-343B and S-344. During IOP WY 2004 (May 1, 2003 through April 30, 2004) through ERTP WY 2015 (May 1, 2014 through April 30, 2015), the initial gate opening for S-12A ranged between July 15 and October 25 with an average initial gate opening date for S-12A of August 9. The range for initial gate opening of the S-12B structure was also July 15 through October 25, with an average initial gate opening date for S-12B of August 7. The Corps also provided an historical overview of S-12A and S-12B gate closure dates. In most years, S-12A closed November 1 as mandated by IOP/ERTP. However, there was variability in the closure date of the S-12B structure. Under IOP and ERTP, the S-12B structure mandated closure period for protection of CSSS is January 1 through July 15 annually. However, over the past twelve Water Years, S-12B closed as early as November 4 (WY 2007) and as late as January 1 (WY 2004), with an average closure date across all years of December 10. These delayed openings and early closures occurred during periods for which the WCA-3A Regulation Schedule does not call for S-12A and S-12B releases.

1.3.1.7. *Preemptive Releases*

Preemptive releases are used to create storage within WCA-3A when large adjustments to inflow into WCA-3A or large regional rainfall events are forecast. Preemptive release amounts are calculated based upon expected inflows into WCA-3A from WCA-1/WCA-2 outlet structures (*i.e.* S-10s/S-11s); and/or forecasted regional rainfall events. When either of these events is predicted to occur, the Corps may utilize the WCA-3A outlet structures, including the S-12 and S-333 structures, to create storage within WCA-3A. Discharges from WCA-3A are discontinued as the Rainfall Plan target flow calculations dictate. An accounting of the amount of water released in excess of the Rainfall Plan target flows is performed each time preemptive releases are utilized. Flexibility associated with preemptive releases assists to maintain target stages within WCA-3A and allows for flexibility in discharges through the S-12 and S-333 structures.

1.4. Future Actions Proposed by the Corps

The Corps is considering four additional measures that they believe may act to further protect CSSS in the future. However, these measures are dependent upon the results of ongoing and future testing or construction of additional features. Although the Corps may propose these measures in future consultation requests, they are not included in the analysis of effects for this Biological Opinion. The Corps has stated that they are committed to implementing these measures if they prove practicable and in compliance with other federal requirements; therefore, water management operations are expected to evolve over the next several years to include the following additional actions:

1) Water Flow Analysis Test;
2) MWD Project Increment 1 Field Test (completion scheduled for Fall 2017);
3) MWD Increment 2 Field Test (completion scheduled for late 2018); and
4) Combined Operational Plan (*i.e.* MWD Increment 3 [COP]) (implementation scheduled for early 2020).

In addition, the Corps is proposing to prepare an assessment, using an interagency team, of potential effects of the L-28 Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further actions; however, the Corps has not yet determined what authority might be required for such actions. The MWD Project Increment 1 Field Test, which was a Term and Condition of the November 17, 2010, ERTP BO, began in October 2015, and includes relaxation of the G-3273 constraint. As part of the MWD Project Increment 1 Field Test, the Corps is required to conduct a spreadsheet tracking analysis to quantify how revised operations under the MWD Increment 1 Field Test would affect flows through the S-12A, S-12B, S-343A, S-343B, and S-344 structures. More details on these proposed future actions can be found in Appendix B of this BO.

1.5. Temporary Emergency Deviations During 2016

The Corps initiated a Temporary Emergency Deviation to Alleviate High Water Levels in Water Conservation Area 3A (WCA-3A) during February 2016. The intent of this deviation was to address high water concerns related to the record El Nino rainfall. The Service responded to the Corps' request for the Temporary Emergency Deviation by letter dated February 11, 2016. On March 1, 2016, the Service received a letter from the Corps requesting informal consultation for the Temporary Emergency Deviation. The emergency deviation is scheduled to remain in place until July 11, 2016. In keeping with standard protocol, the Service will wait until the emergency action is complete to offer its official regulatory response and concurrence if appropriate. In the interim, the Service requested the Corps to consider combining many of the actions taken during this most recent emergency action into their analysis for ERTP-2016.

Due to the very strong El Nino this dry season, WCA-3A has experienced unseasonably high water levels. Therefore, the Jacksonville District initiated a temporary deviation for 90 days to increase the operational trigger level in the L-29 Canal from an elevation of 7.5 feet to 8.5 feet, NGVD, between structure S-333 and S-334 and other necessary changes to the Central and Southern Florida Project (C&SF) operations that are required to support this change. These operational changes will allow for the full discharge capacity through S-333 helping to mediate the high water in WCA-3A. The other operational changes will mediate any concern with increased seepage from Everglades National Park (ENP) into the South Dade Conveyance System.

The Corps prepared a Supplemental Environmental Assessment (EA) to evaluate the effects of the Temporary Emergency Deviation. The Finding of No Significant Impact (FONSI) was signed on May 10, 2016. The water management operating criteria relating to the action affects an area within the C&SF Project located in south Florida and includes WCA 3, ENP, and adjacent areas. Features of the action are located in Broward and Miami-Dade Counties.

The Complete Initiation Package for the Service included species affects determinations and the Operational Strategy for the emergency action. There are several actions that the Corps, in conjunction with the District and other partners, implemented during the emergency response that have not been available or utilized during prior high-water emergencies, which may prove beneficial to CSSS in the future. These include utilizing more capacity in WCA-3B while installing temporary pumps at the S-355 structures to evacuate excess water, using C-111 detention area capacity when available, and most importantly, raising the operational stage limit in the L-29 Canal to up to 8.5-ft NGVD. Raising this stage allows a significant increase in discharge from WCA-3A into the historic flow path of Northeast Shark River Slough and has been the main objective of Modified Water Deliveries and other CERP projects for well over a decade.

The emergency action plan seemed to work well. Southern WCA-3A water levels receded to 10.8 feet NGVD by March 14, in part due to drier weather conditions. ERTP closure periods on the S-12A, S-12B, S-343A, S-343B and S-344 structures, designed for protection of CSSS-A, remained in place throughout the deviation. Despite the intent to keep these protections in place, the gates were opened on February 22 and were closed on March 10. Although included in the 2012 WCP, the opening of the S-12A structure necessary to prevent overtopping concerned the Service because it increased water levels in CSSS-A. While the effect of opening this structure was negligible on water levels in WCA-3A the impact to CSSS-A was noticeable and resulted in an elimination of available nesting habitat two weeks into the sparrow nesting season by placing an additional 4 inches of water across the western marl prairie south of S-12A.

On April 10, 2016, the Corps requested informal consultation for the temporary emergency deviation at the S-344 structure to alleviate high water levels in WCA-3A. This structure has a mandated closure during the CSSS breeding period along with the S-343A/B and S-12A/B. This deviation opened the S-344 immediately instead of waiting until the opening date of July 15. Along with this deviation, the Governor of Florida declared an emergency order that provided funds for the District to repair six plugs in the L-28 canal. These plugs were intended to prevent S-344 flow from going south in the L-28 Canal, into the S-12A area and ultimately into the western marl prairie of CSSS-A. The plugs are also there to promote flows from the S-344 into the landscape of Big Cypress National Preserve.

It was determined on April 21, 2016, that the S-344 was already discharging water at a rate of 40 cfs into the L-28 due to the failure of the culvert. The District completed the repair of the six plugs in the L-28 canal and the S-344 was opened full with a discharge of 150 cfs on May 20, 2016. The structure remains open at this time.

2. CAPE SABLE SEASIDE SPARROW

2.1. STATUS OF THE SPECIES

This section summarizes the effects of all past human and natural activities or events that have led to the current status of the CSSS and are relevant to formulating the biological opinion about the proposed action.

2.1.1. Species Description

The CSSS is one of eight extant subspecies of seaside sparrow in North America. Its distribution is limited to the short-hydroperiod wetlands, or marl prairies, located at the southern end of the greater Everglades ecosystem, on the southern tip of mainland Florida. The CSSS is a medium-sized bird, 5.1 to 5.5 inches in length (Warner 1975). Unlike most other subspecies of seaside sparrow, which occupy primarily brackish tidal systems (Post and Greenlaw 1994), this sparrow currently occurs primarily in the short-hydroperiod wet prairies, also referred to as marl prairies. The sparrow is generally sedentary, secretive, and non-migratory, although sparrows are known to disperse between subpopulations (Lockwood et al. 2008; Virzi et al. 2009).

2.1.2. Reasons for Listing

The CSSS was one of the first species listed on March 11, 1967, under the Endangered Species Preservation Act of 1967 (32 FR 4001). The subspecies' limited distribution, small population size and threats to its habitat resulted in its listing under the Endangered Species Act in 1967. Protection for the sparrow was continued under the Endangered Species Conservation Act of 1969. The sparrow and all the other species listed under the Endangered Species Conservation Act of 1969 were also listed as endangered under the Act of 1973.

From its initial discovery in the cordgrass (*Spartina* spp.) marshes on Cape Sable in 1918 (Howell 1919), followed by reports in what is now Everglades City (Nicholson 1928) as well as Ochopee (Anderson 1942), CSSS have experienced hurricanes, fires, and habitat transitions. These historic populations have since been extirpated, but in 1972, sparrows were discovered near Taylor Slough (Ogden 1972). Subsequent investigation revealed that a sparrow had been reported in this area in 1958, but the observation was never verified (Werner 1975; Pimm et al. 2002). Werner conducted helicopter surveys in 1974 and 1975 to characterize the distribution and abundance of sparrows in this region. These initial surveys revealed that sparrows were widely distributed and abundant (Werner 1975). A subsequent 1981 survey (Kushlan and Bass 1983) delineated the six subpopulations that are currently monitored.

2.1.3. Life History

2.1.3.1. *Breeding and Nesting Behaviors*

CSSS are thought to be generally monogamous (Post and Greenlaw 1994), with a single female occurring within a male's breeding territory. However, there are indications that sparrows may be polygamous under some circumstances, such as within small populations; it is unknown whether the sparrows are simultaneously or sequentially polygamous (Lockwood et al. 2006).

During the breeding season, typically considered March 1 through July 15, but which can extend through August, male sparrows establish and defend territories that are variable in size, ranging from 0.7 to 16.8 acres (Werner 1975), with reported average sizes ranging from 2.2 to 8.9 acres (Werner and Woolfenden 1983; Pimm et al. 2002). Throughout the breeding season, the majority of a sparrow pair's activities occur within this territory, including breeding, feeding, and sheltering. Within an area of suitable habitat, territories do not appear to be tightly packed (Werner 1975), and there are gaps between defended boundaries of adjacent males. Even when sparrows occur at high densities, small areas usually remain between adjacent territories, though some territories do appear to overlap (Cassey et al. 2007). Therefore, some gaps that appear to be suitable habitat may remain unclaimed by territorial sparrows (Werner 1975). It is likely that sparrows venture into these "unclaimed areas" during the breeding season. In many cases, areas that appear to be suitable for sparrow occupancy may not be suitable during certain environmental conditions and this may cause sparrow territories to appear to be widely separated from neighboring territories (Cassey et al. 2007).

Outside of the breeding season (August to February), sparrows generally remain sedentary in the general vicinity of their breeding territories, but expand the area that they use compared to the breeding season territory (Dean and Morrison 2001). The average non-breeding season home range is approximately 42 acres, with a range of 14.1 to 137.1 acres (Dean and Morrison 2001). Some individuals make exploratory movements away from the area of their territories, and may occasionally relocate their territories and home ranges before resuming a sedentary movement pattern (Dean and Morrison 2001).

Sparrows generally begin nesting in early March (Lockwood et al. 2001), but may begin territorial behavior, courtship, and nest-building in late February (Werner and Woolfenden 1983; Lockwood et al. 1997). This timing coincides with the dry season, and most areas within the marl prairies are either dry or only shallowly inundated at the beginning of the breeding season. During the dry portion of the breeding season (March to May), sparrows build nests above the ground, but relatively low in the vegetation (6.7 to 7.1 inches) (Werner 1975; Lockwood et al. 2001). Nests are woven into clumps of dense vegetation and are well-concealed (Werner 1975; Post and Greenlaw 1994). Nest cups are consistently concealed from above (Post and Greenlaw 1994), either through construction of a domed cover or through modifying vegetation in the vicinity (Werner 1975; Post and Greenlaw 1994). During the wet portion of the sparrow breeding season (June to August), sparrows build their nests higher in the vegetation than during dry periods, an average of 8.3 inches above the ground surface (Lockwood et al. 2001). Wet-season nests probably occur in taller prairie grass vegetation than during the dry season because there must be sufficient height and density of vegetation remaining above the nest to cover and conceal nests.

Pimm et al. (2002) suggest that nesting will not be initiated if water levels are at a depth greater than 4 inches during the breeding season. For many years, rising water levels resulting from the onset of summer rains were thought to end the breeding season (Werner 1975). While these statements are generally true, the sparrows may respond to changes in hydrologic conditions as long as water levels are not prohibitively high. Large rainfall events early in the wet season may cause some nest failure and sparrows generally cease breeding when water levels rise above the mean height of the nests above the ground (Lockwood et al. 1997; Basier et al. 2008; Cade and Dong 2008). However, if water levels subsequently drop, sparrows may again initiate breeding activity. The initiation of molt, which usually occurs in early September, is probably the best indicator of the true end of the breeding season.

CSSS lay three to four eggs per clutch (Werner 1978, Pimm et al. 2002) with a hatching rate ranging between 0.66 and 1.00 (Boulton et al. 2009). The sparrow nesting cycle, from nest construction to independence of young, lasts between 30 and 45 days (Werner 1975; Lockwood et al. 2001; Pimm et al. 2002), and sparrows may renest following both successful and failed nesting attempts (Werner 1975; Post and Greenlaw 1994; Lockwood et al. 2001). A three-clutch breeding season necessitates an uninterrupted period of 90 to 120 days of maximally favorable conditions (Lockwood et al. 2001; Elderd and Nott, 2008). Both parents rear and feed the young birds and may do so for an additional 10 to 20 days after the young fledge (Woolfenden 1956, 1968; Trost 1968). Sparrows are incapable of flight until they are about 17 days old; when approached, flightless fledglings will freeze on a perch until the threat is less than approximately 3 ft away, and then run along the ground (Werner 1975; Lockwood et al. 1997).

Because of the long breeding season in southern Florida (March – August), optimal conditions may allow sparrows to nest several times within a year, and they may be capable of successfully fledging two to four clutches. Few sparrows probably reach this level of success (Lockwood et al. 2001) since second and third nesting attempts may occur during the early portion of the wet season. Nests initiated later in the season usually occur over water and result in reduced success rates.

Nest success rates vary among years, and range from 12 to 60 percent, depending upon time within the breeding season (Lockwood et al. 2001; Baiser et al. 2008; Boulton et al. 2009; Slater et al. 2014). Substantially higher nest success rates occur within the early portion of the breeding season (prior to June 1) followed by a decline in success as the breeding season progresses to a low of about 20 percent after June 1. Nest predation is the primary documented cause of nest failure (Pimm et al. 2002; Baiser et al. 2008; Boulton et al. 2009; Virzi et al. 2009; Slater et al. 2014), accounting for more than 75 percent of all nest failures (Lockwood et al. 1997; Baiser et al. 2008). A complete array of nest predators has not been determined, however, raccoons (*Procyon lotor*), rice rats (*Oryzomys palustris*), and snakes, including exotic pythons may be the predominant predators (Lockwood et al. 1997; Post and Greenlaw 2000; Dean and Morrison 2001). It is also possible that as exotic tegus continue to expand their range they may become a significant predator for CSSS (Mazzotti 2015). As water levels begin to rise above ground surface with the onset of the summer rains in May to June, nest predation rates also rise. Nests that are active after June 1, when water levels are above ground, are more than twice as likely to fail as nests during drier periods (Lockwood et al. 2001; Baiser et al. 2008; Cade and Dong 2008). This effect appears to be the result of both increased likelihood of nests being flooded and an increased likelihood of predation (Lockwood et al. 1997, 2001; Pimm et al. 2002).

CSSS are generally short-lived, with an average individual annual survival rate of 66 percent (Lockwood et al. 2001). The average lifespan is probably 2 to 3 years. Consequently, a sparrow population requires favorable breeding conditions in most years to be self-sustaining, and cannot persist under poor conditions for extended periods (Lockwood et al. 1997, 2001; Pimm et al. 2002).

2.1.3.2. *Feeding Behavior*

While detailed information about the diet of CSSS is not known, invertebrates comprise the majority of their diet, though sparrows may also consume seeds when they are available (Werner 1975; Post and Greenlaw 1994). Howell (1932) identified the contents of 15 sparrow stomachs and primarily found remains of insects and spiders, as well as amphipods, mollusks, and plant matter. Primary prey items that are fed to nestlings during the breeding season include grasshoppers (*Orthoptera*), moths and butterflies (*Lepidoptera*), dragonflies (*Odonata*), and other common large insects (Post and Greenlaw 1994; Stevenson and Anderson 1994; Lockwood et al. 1997; Pimm et al. 2002). Adult sparrows probably consume the same species during the nesting season. Sparrows may consume different proportions of different species over time and among sites, suggesting that they are dietary generalists (Pimm et al. 2002). During the non-breeding season, preliminary information from evaluation of fecal collections suggests that a variety of small invertebrates, including weevils and small mollusks are regularly consumed (Dean and Morrison 2001). Evidence of seed consumption was only present in 4 percent of samples (Dean and Morrison 2001). These non-breeding season samples may not be representative of the foods most frequently consumed during that season and may only represent a portion of the items ingested.

While the sparrow appears to be a dietary generalist, an important characteristic of sparrow habitat is its ability to support a diverse array of insect fauna. In addition, these food items must be available to sparrows both during periods when there is dry ground and during extended periods of inundation. The specific foraging substrates used are unknown, but they probably vary throughout the year in response to hydrologic conditions.

2.1.4. Habitat

CSSS subpopulations require large patches of contiguous open habitat. The minimum area required to support a population has not been specifically determined, but the smallest area that has remained occupied by sparrows for an extended period is about 4,000 acres. Individuals are area-sensitive and generally avoid the edges where other habitat types meet the marl prairies. They will only occupy small patches (less than 100 acres) of marl prairie vegetation when they occur within large, expansive areas and are not close to forested boundaries (Dean and Morrison 2001). Large expanses of deep water or wooded habitat may act as barriers to long-range movements (Dean and Morrison 2001). Once sparrows establish a breeding territory, they exhibit high site fidelity, and each individual sparrow may only occupy a small area for the majority of its life (Warner 1975). Although sparrows are generally sedentary, recent research has revealed occasional movement between subpopulations east of SRS (Lockwood et al. 2008; Virzi et al. 2009). However, sparrow dispersal probability declines greatly over longer distances and thus the likelihood of sparrows from other subpopulations decreases as distances increase (Gilroy et al. 2012). CSSS most consistently occur and are most abundant near the center of the patch of habitat in which they occur.

CSSS occur mostly within the short-hydroperiod freshwater marl prairies of the southern Everglades that flank the deeper sloughs. The most commonly associated vegetation species in occupied freshwater habitat is muhly grass (*Muhlenbergia filipes*) (Werner 1975; Kushlan and Bass 1983; Werner and Woolfenden 1983; Post and Greenlaw 1994; Stevenson and Anderson 1994), but CSSS also occur in freshwater marl prairies where *Muhlenbergia* is absent (Ross et al. 2006). Other dominant species that occur in these prairies include sawgrass (*Cladium jamaicense*), south Florida bluestem (*Schizachyrium rhizomatum*), black-topped sedge (*Schoenus nigricans*), and beak rushes (*Rhynchospora* spp.) (Werner and Woolfenden 1983; Ross et al. 2006).

CSSS occupy these marl prairie communities year-round during all life stages. During the dry season, usually coinciding with the late winter and early spring (November to May), sparrows traverse the ground surface beneath the grasses, and only occasionally perch on the vegetation. During the wet season (June to October), the ground surface is inundated, with peak water depths occasionally exceeding 2 ft (Nott et al. 1998). Sparrows travel within the grasses, perching low in the vegetation, hopping among the bases of dense grass clumps, walking over matted grass litter, and flying more frequently than during the dry season, but generally remain inconspicuous (Dean and Morrison 2001).

Hydrologic conditions have significant direct and indirect effects on sparrows. First, water depth or depth of inundation within sparrow habitat is directly related to the sparrow's ability to move, forage, nest, find shelter, and avoid predators and harsh environmental conditions. Average annual rainfall in the Everglades is approximately 56 inches per year (ENP 2005), with the majority of this falling within the wet season months (June-October), which coincides with the latter half of the sparrow nesting season. This rainfall drives hydrologic characteristics in the marl prairies; however, throughout southern Florida, water management actions also influence hydrologic conditions. The operation of a system of canals, levees, pumps, and other water management structures affects much of the remaining marl prairies (Johnson et al. 1988; Van Lent and Johnson 1993; Pimm et al. 2002).

At water depths greater than 2 ft above ground surface, the majority of the vegetation in sparrow habitat is completely inundated, leaving sparrows with limited refugia. Conditions such as these may result in significant impacts to sparrow survival, and if they occur during the breeding season, can cause loss of sparrow nests (Nott et al. 1998; Pimm and Bass 2002). Even more moderate water levels, in the range of 6 inches above ground surface, may inundate enough habitat that sparrows cannot find shelter and are restricted in their movements. These water levels, when they occur during the breeding season, result in increased rates of nest failure (Lockwood et al. 1997; Baiser et al. 2008). While topographical variation within the remaining Everglades is relatively small, differences in elevation as little as 1 ft are associated with substantial differences in habitat characteristics.

The composition and structure/density of plant communities in the Everglades are strongly influenced by the rise and fall of annual water levels, which is measured as the number of days of inundation per year, or annual hydroperiod. Water quality has the potential to influence vegetation communities in sparrow habitat, but the literature summarized below highlights the more dominant role of hydroperiod and fire. Hydroperiods that range from 60 to 270 days support the full variety of vegetation conditions that are generally suitable for sparrows (Ross et al. 2006), though the vegetation composition and structure may vary significantly. Persistent increases in hydroperiod may alter vegetation communities from marl prairies or mixed prairies to sawgrass-dominated communities resembling sawgrass marshes (Nott et al. 1998). Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 60 to 180 days in most years is optimal for the plant species that support sparrow nesting and otherwise maintain sparrow habitat (Olmsted 1984; Kushlan et al. 1982; Kushlan 1990a; Wetzel 2001; Ross et al. 2006, Sah et al. 2013).

Average hydroperiods that extend much beyond 240 days per year are associated with sawgrass marsh communities (Ross et al. 2006, Sah et al 2013) which are unlikely to support sparrows in the long term. Conversely, areas that are frequently subjected to short hydroperiods generally have higher fire frequency (Lockwood et al. 2003; Ross et al. 2006), and are readily invaded by woody shrubs and trees (Werner 1975; Davis et al. 2005). Both an increased incidence of fire and an increased density and occurrence of woody shrubs reduce the suitability of an area as sparrow habitat.

Small tree islands and individual trees and shrubs occur throughout the areas occupied by the sparrows, but at a very low density. Sparrows do not appear to require woody vegetation for any aspect of their normal behavior, and generally avoid areas where shrubs and trees are either dense or evenly distributed. However, the small tree islands and scattered shrubs and trees may serve as refugia during extreme environmental conditions, and may serve as escape cover when fleeing from potential predators (Dean and Morrison 2001). Because of their general aversion to dense trees and woody vegetation, encroachment of trees and shrubs quickly degrades potential sparrow habitat. However, a heterogeneous arrangement of different vegetation conditions provides habitat for sparrows under variable environmental conditions. A complex relationship between hydrologic conditions, fire history, and soil depth determine the specific vegetation communities at a particular site, and variation in these characteristics may result in a complex mosaic of vegetation (Taylor 1983; Ross et al. 2006). Kushlan and Bass (1983) conclude that a combination of hydroperiod and periodic fire events is critical in the maintenance of suitable mixed marl prairie communities for the sparrow. CSSS are generally not found in communities dominated by dense sawgrass, cattail (*Typha* spp.) monocultures, long-hydroperiod wetlands with tall, dense vegetative cover, spike rush (*Eleocharis cellulosa*) marshes and sites supporting woody vegetation (Werner 1975, Bass and Kushlan 1982). Sparrows also avoid sites with permanent year-round water cover (Curnutt and Pimm 1993).

Sparrows do not regularly occupy burned areas for 2 to 3 years following fires (Pimm et al. 2002; Lockwood et al. 2005), though they can re-occupy areas after only 1 year post-fire under some conditions (Taylor 1983; Werner and Woolfenden 1983). This is probably because of the sparrow's dependence on a level of structural complexity in the vegetation, which is absent after a fire, to provide cover, support nests, and allow individuals to move through the habitat during wet periods. Fire is common within the areas occupied by sparrows, and nearly all areas where sparrows currently occur have been burned within the past 10 to 20 years (Lockwood et al. 2003; LaPuma et al. 2007; Sah et al. 2013). A combination of naturally ignited and human-ignited (both prescribed and arson/accidental ignition) fires have resulted in different fire frequencies in different portions of the sparrow's range. Most of the species of vegetation that occur within sparrow habitat are fire-adapted and respond quickly following fire (Snyder 2003). Several of the dominant grass species, including *Muhlenbergia*, also flower following fires during the growing season (Main and Barry 2002). Under normal conditions, fires do not kill the individual plants that make up the dominant species in sparrow habitat, and fires remove only the aboveground growth and leaf litter (Snyder and Schaeffer 2004). Many of the dominant grasses may grow more than 15 inches after only a few weeks (Steward and Ornes 1975; Snyder 2003). For this reason, the species composition and even the general structural characteristics of the vegetation may be nearly indistinguishable from unburned areas only 2 to 3 years after burning (Lockwood et al. 2005).

The interaction of fire and flooding strongly influence the suitability of habitat for sparrows. In the most extreme case, vegetation that burns and is subsequently flooded within 1 to 3 weeks, either because of a natural rainfall event or water management operations, may not recover for up to 10 or more years (Ross 2006). If water levels overtop sprouting grasses after a fire, the grasses may die, resulting in an absence of vegetation. Recovery of vegetation from these circumstances is via seed germination, which requires a longer time than recovery via vegetative growth, and may result in a different plant species community (composition and structure) than was present prior to the fire. Under more suitable conditions, vegetation may recover more quickly following fire when water levels are near the soil surface, providing ample water for the plants to grow, without changing the plant community species composition.

2.1.5. Population Dynamics

2.1.5.1. *Population Size and Variability*

The use of helicopters to facilitate larger spatial-scale surveys for the sparrow was first accomplished in 1974 (Werner 1975). The first comprehensive, range-wide sparrow population survey was conducted in 1981, but was not repeated until 1992. Since that time, surveys have been conducted annually including twice in 1999 and 2000 (Pimm et al. 2002). The number of survey locations has changed through time, from a high of over 850 sites in 1992 to a low of 250 sites in 1995 (Cassey et al. 2007). The results of these annual helicopter surveys are used to estimate the CSSS population. An assumption of the annual population estimate calculations based on the range wide helicopter surveys (Pimm et al. 2002) is that every male detected calling also accounts for one female in the population (*i.e.* they are paired), resulting in a sex ratio of 0.5. To estimate the total number of sparrows from the number observed on helicopter point counts, a correction factor is needed. Bass and Kushlan (1982), used a value of 15.87 (rounding it to 16) based on the range at which they could detect the sparrow's song (detection distance of a singing sparrow [200 m] resulting in a census coverage of 12.6 ha at each site visited), and on the assumption that each singing male was accompanied by one female ((100 ha/km^2 ÷ 12.6) X 2).

Over the period that rangewide helicopter surveys have been performed, there have been substantial demographic changes in most of the six subpopulations (Table 1) (Tables referenced in this BO are included at the end of the document in section 12). The 1981 and 1992 sparrow surveys provided a baseline of the distribution and abundance of sparrows at that time, though there is no information available about how the populations may have changed during the intervening 11 years. In 1981, there were an estimated 6,656 sparrows distributed across six subpopulations, with the majority (86 percent) of the sparrows occurring within subpopulations A, B, and E. By comparison, the last complete CSSS population survey for all the subpopulations (2015) resulted in an estimate of 3,216 sparrows, with the majority of birds occurring within subpopulation B (60 percent) and subpopulation E (27 percent). Preliminary survey results for 2016 indicate a substantial drop in the estimated population of sparrows, from 3,216 in 2015 to 2,416 in 2016.

Subpopulation A inhabits the marl prairies west of SRS in ENP and eastern Big Cypress National Preserve (BCNP), (Figure 3). In 1981 and 1992, subpopulation A supported over 40 percent (2,600 sparrows) of the total CSSS population (Table 1). Subpopulation A experienced the most dramatic population decline observed, dropping from more than 2,600 birds in 1992 to 432 birds in 1993 a decrease of 84 percent (Curnutt et al. 1998, Pimm et al. 2002). It is likely that Hurricane Andrew, in August 1992, caused mortality within most subpopulations but details suggest that Andrew was not the major cause of the overall population decline (Curnutt et al. 1998, Nott et al. 1998). Andrew was followed by several wet years and high discharges of water through water control structures which caused several years of poor conditions for the CSSS, reducing its ability to recover from the impact of the hurricane (Curnutt et al. 1998, Nott et al. 1998). The sharp decline in sparrow subpopulation A corresponds to a change from four drier than average years prior to 1992 to four wetter than average years between 1993 and 1996 when only limited breeding was possible and vegetation changes were documented (Nott et al. 1998, Jenkins et al., 2003). Lockwood et al. (2001) demonstrated that after experiencing three years of poor breeding conditions in quick succession CSSS populations will decline sharply. Subpopulation A has subsequently remained at a low level, ranging from a high of 448 sparrows in 2000 to a low of 16 sparrows in 2004. The most recent population estimate for CSSS-A was 208 sparrows in 2015. Subpopulation A now accounts for only 6 percent of the total CSSS population. The continued low population numbers in subpopulation A are a major concern due to this subpopulation historically providing over 40 percent of the total population. It has been hypothesized that subpopulation A could be approaching a minimum threshold necessary to promote settlement of breeding sparrows and that local recruitment and dispersal rates alone will unlikely be sufficient to enable this sparrow subpopulation to persist (Virzi and Davis 2013, Slater et al. 2014).

Subpopulation B, inhabiting the marl prairies southeast of SRS near the center of ENP, has remained relatively stable over time. When first surveyed in 1981, subpopulation B contained an estimated 2,352 sparrows (35 percent of the total population). Subpopulation B remains one of the most abundant subpopulations, with the estimated population size from 1981 to 2015 ranging from 1,792 to 3,184 sparrows (Table 1). Even though subpopulation B is the largest remaining subpopulation, a general downward trend in the estimated population has been noticed over the period of record. The subpopulation averaged 2,320 birds between 1992 to 2007. However, the average estimated population of subpopulation B since that period has been 1,860 birds. As of 2015, subpopulation B remains one of the most abundant subpopulations, with its population containing 1,920 sparrows, comprising approximately 60 percent of the current population.

In 1981, subpopulation C, located in the vicinity of Taylor Slough and along the eastern boundary of ENP, contained an estimated 432 sparrows (6 percent of the total population). By the 1992 survey, subpopulation C had declined nearly 90 percent, to 48 sparrows (Table 1). The population has remained very low since 1992, with two years where no sparrows were detected (1993 and 1995). There were only 48 sparrows estimated in this area in 1996 and 1997, and 80 sparrows estimated in 1998. Between 2007 and 2010, the population declined to an estimated 32 to 48 sparrows. However, since 2010, the sparrow population in subpopulation C has increased slightly and has been hovering around an estimated average of 125 sparrows (30 percent of its 1981 estimated population size).

Subpopulation D, just to the southeast of subpopulation C, supported an estimated 400 sparrows in 1981 (approximately 6 percent of the sparrow population), but declined to approximately 96 sparrows in 1993 (Table 1). High water levels likely led to the decrease in population since 1999 (Slater et al. 2009) with 32 sparrows estimated in 2000. No sparrows were identified within subpopulation D in 1995, 2002, 2003, 2004, 2006, and 2007. When birds have been detected, the number of males consistently exceeds the number of females (Virzi and Davis 2012, Virzi and Davis 2013, Virzi et al. 2011). Lockwood et al. (2008), observed that the continued population decline, since its estimate of 400 sparrows in 1981, had possibly left this subpopulation functionally extirpated. Surveys from 2008 through 2015 documented a few sparrows in this subpopulation with an estimated population range of 16 to 64 sparrows, with the exception of 2012 when the estimate was 224 sparrows. Intensive ground monitoring activities in this subpopulation indicate that the actual number of birds in this subpopulation may be far fewer. This area, like subpopulation A, has suffered from persistent high water levels that may have precluded sparrows from nesting in many of these years.

Subpopulation E, north of subpopulation B and east of SRS, contained over 10 percent of the total population (approximately 672 sparrows) in 1981. Following Hurricane Andrew, subpopulation E declined by about 50 percent (Curnutt et al. 1998). However, due to the presence of suitable conditions, this subpopulation, like subpopulation B, has remained relatively stable even though it has experienced wide interannual fluctuations (Table 1). Between 2010 and 2015 the estimated population ranged from 592 to 912 sparrows with the most recent survey in 2015, estimating a population of 880 sparrows.

Subpopulation F, located between SRS and the western edge of the Atlantic coastal ridge along the eastern boundary of ENP, was the smallest subpopulation in 1981, containing an estimated 112 sparrows or just 2 percent of the total population. Population estimates for subpopulation F declined from 1981 to 1992, from 112 sparrows to 32 sparrows (Table 1). In several years (1993, 1995, 1999, 2000, 2007, 2008, and 2009) no birds were detected during the surveys. Only 16 sparrows were estimated for each year from 1996 to 1998, 2002, 2004, 2010, 2013, and 2014 (ENP 2005). Since 2010 the estimated population has ranged between 16 and 64 sparrows, with 32 sparrows estimated in 2015.

Subpopulations A, C, D and F are currently the smallest in terms of number of sparrows. Since subpopulations A, B and E have consistently held sparrows over all survey years they are considered "core" subpopulations and essential to the survival of the species. Subpopulation A has a large amount of previously occupied habitat which has the potential for restoration given the proper hydrologic regime. During the 2006-2008 nesting seasons, intensive ground surveys were conducted in subpopulations C, D, and F to better understand these small subpopulations (Lockwood et al. 2006; Boulton et al. 2009). Data collected in these surveys included territory size, fecundity, nest success and survival rates. Results indicate that the small subpopulations exhibit: 1) suppressed breeding, 2) an excess of unpaired males, 3) nest survival comparable to larger subpopulations, 4) low hatch rate, and 5) larger territory sizes than birds in the larger subpopulations. Boulton et al. (2009) concluded that the small subpopulations are demographically dynamic and subject to the negative effects of low densities (*e.g.*, allee effects). Allee effects often make it difficult 1) for breeding adults to find each other to mate, 2) to assess the condition of potential breeding habitat and 3) to ward off predators of adults and nests (Reed 1997, Etterson 2003). Recent surveys in subpopulation D have revealed results demonstrating the effects of small population size (Virzi and Davis 2013, Slater et al. 2014). In addition to C and D, subpopulation A was intensively surveyed beginning in 2009 (Virzi et al. 2009). Nineteen breeding pairs were detected in CSSS-A during intensive ground surveys, and the subpopulation exhibited similar traits to the larger subpopulations such as the presence of few unmated males, and comparable clutch sizes, adult return rates, and proportion of early to late nests (Virzi et al. 2009). The subpopulation was reported as extant and functional. However, recent surveys between 2011 and 2015 found that the number of breeding pairs within subpopulation A has decreased leading to concerns that subpopulation A could be approaching or already is below a minimum threshold necessary to promote settlement of breeding sparrows, perhaps due to a lack of conspecific cues. Additionally, past low nest success rates and current low return rates raise the concern that this subpopulation may face continued declines unless the cause of the lower demographic rates can be identified and managed (Slater et al. 2014).

There have been large population declines recorded among most of the subpopulations and relatively few large population increases since 1981, especially in the smaller subpopulations and specifically CSSS-A. These population changes suggest that while declines can occur rapidly, it may take many years of favorable conditions to return a sparrow population to its previous status (Jenkins et al. 2003; Cassey et al. 2007; Lockwood et al. 2008). The continued population decline is a major concern. Since the significant decline in sparrow numbers in 1993, the overall population has varied from a low of 2,416 birds in 1994 to a high of 4,048 birds in 1997. Since 2001, the population estimates have ranged from a high of 3,584 in 2004 to a low of 2,720 in 2014. Understanding these population changes, especially in small subpopulations, is often complicated by discrepancies between population estimates based on rangewide helicopter survey results and intensive ground monitoring. For example, based on intensive ground surveys in selected areas, the number of sparrows in CSSS-A dropped between 2010 and 2011, largely due to a reduction in females. Between 2010 and 2011 the number of males decreased from 24 to 16 while the number of females decreased from 19 to 6 within the study plot. The numbers dropped again between 2012 and 2014 due to a reduction in single males (Slater et al. 2014). Population estimates based on helicopter counts do not closely follow these trends. This can be partially explained by the fact that helicopter surveys only detect males and that they are conducted on a much larger rangewide subpopulation level scale than intensive ground monitoring which concentrates on intensive data collection within a much smaller area, usually within optimal habitat conditions.

2.1.5.2. ***Population Stability***

Current information suggests that sparrow subpopulations C, D, and F may support fewer sparrows than previously estimated, and the demographics of these subpopulations may differ from the larger subpopulations (Lockwood et al. 2006, Virzi and Davis 2013). Because sparrows typically experience low nest survival, low juvenile survival, and have a relatively short life span, we cannot expect sparrow recovery to be rapid (Lockwood et al. 2001). The demographic attributes of sparrows preclude them from rapid recovery particularly when consistently faced with poor conditions (*i.e.*, high water levels and frequent fires) (Lockwood et al. 2008). This affects assessment of the likelihood of the persistence of these subpopulations and the overall probability of persistence for the species.

With smaller population sizes in subpopulations C, D, and F, the relative importance of subpopulations A, B and E is increased with respect to maintaining a viable overall sparrow population. Similarly, potential contributions of the small subpopulations to maintaining the overall sparrow population and buffering it from potential catastrophic events such as widespread fire and hurricanes are reduced (Lockwood et al. 2006). Pimm et al. (2002) and Walters et al. (2000) suggested that three breeding subpopulations are necessary for the continued long-term survival of the sparrow. However, Slater et al. (2009) emphasize the need to recover all subpopulations, noting that with a vast majority of sparrows concentrated within subpopulations B and E, the species' vulnerability to stochastic events is particularly acute.

Slater et al. (2009) observed that even though the overall sparrow population has remained somewhat stable since the massive decline it experienced in the early 1990s, the population has shown minimal signs of recovery. The SEI (2007a) panel also concluded:

> "More important than trying to delineate populations, is recognizing that protecting the subspecies from catastrophic events will require maintaining sparrows over as wide an area as possible. This recognition actually provides a more compelling rationale for maintaining subpopulation A than the need to maintain three populations did, since subpopulation A is the only subpopulation west of SRS. It also suggests more emphasis should be placed on maintaining subpopulation D as the southeastern-most subpopulation".

2.1.6. Distribution

The CSSS was first discovered in the cordgrass (Spartina spp.) marshes on Cape Sable in 1918 and was originally thought to be limited in distribution to Cape Sable (Howell 1919). On September 2, 1935, a severe hurricane struck the Keys and southern Florida, with the hurricane's center passing within a few miles of Cape Sable (Stimson 1956). Post-hurricane observations in the vicinity of Cape Sable suggest that water levels resulting from the storm surge rose about 8 ft above normal water levels, and the sparrow was thought to have been extirpated from the area due to habitat degradation as a result of the storm surge. Between 1935 and the 1950s, searches on Cape Sable failed to locate sparrows, however there were occasional reports of sparrows that could not be verified (Stimson 1956). Despite the fact that sparrows were again reported on Cape Sable in 1970 (Kushlan and Bass 1983; Werner and Woolfenden 1983), the habitat in the area had changed significantly from cordgrass marshes to mangroves and mud flats since the 1935 hurricane, and sparrows were considered to have been extirpated from this area since 1981 (Kushlan and Bass 1983).

In 1928, CSSS were reported to the northwest of Pinecrest, along the mainland coast of Florida, near what is today Everglades City (Nicholson 1928). The location of this mainland record was improperly reported, and the true location, Lostmans Pine Islands area approximately 5 miles southwest of Pinecrest, was not accurately reported until 1954 (Sprunt 1954). Stimson conducted extensive searches on the Florida mainland in the vicinity of the corrected 1928 sparrow observation, and found sparrows to be very widespread throughout both coastal cordgrass marshes (Werner and Woolfenden 1983) and freshwater prairies along the western edge of the Everglades (Stimson 1956). However, by 1968, Stimson (1968) concluded that widespread fires in this region had severely impacted the sparrows in that area, and he expected them to be extirpated from the area as a result.

In the early 1940s, Anderson (1942) reported sparrows in the coastal cordgrass marshes near Ochopee. Subsequent searches revealed that sparrows occurred south of Ochopee along the coastal marshes landward of the mangrove zone (Stimson 1956). Werner (1975) reported that habitat occupied by sparrows in the Ochopee area was changing from cordgrass marshes to other species, and mangroves were encroaching into the area. Werner's searches in the area from 1970 through 1975 revealed a decline in the number of sparrows and the amount of habitat available in the area (Werner 1975). Sparrows were extirpated from this area by 1981 (Kushlan and Bass 1983), and there is little or no suitable habitat remaining in the area.

In 1972, CSSS were discovered near Taylor Slough (Ogden 1972). Subsequent investigation revealed that a sparrow had been reported to ENP in this area in 1958, but the observation was never verified (Werner 1975; Pimm et al. 2002). Surveys conducted by Werner in 1974 and 1975 with the use of a helicopter, sought to characterize the distribution and abundance of sparrows in this region. These initial surveys revealed that sparrows were widely distributed and abundant (Werner 1975). They occupied an area of about 21,745 to 31,629 acres, and the number of sparrows occurring within this area was estimated to range from 1,500 to 26,300 individuals (Werner 1975). Because of the magnitude of the area occupied and the large estimates of population size, ecologists concluded that sparrows probably occurred within this area for many years. The difficulty in accessing the areas and the vastness of the areas (Kushlan and Bass 1983), as well as the secretiveness of the sparrow, all contributed to the failure to document the sparrow's occurrence in the area previously. The sparrow populations within these areas probably fluctuated over time in response to changes in habitat suitability resulting from fires and hydrologic conditions (Taylor 1983; Kushlan and Bass 1983). These fluctuations may have also contributed to the lack of sparrow detections in these areas.

The 1981 sparrow survey provided a good baseline on the distribution and abundance of sparrows at that time, and the 1992 survey results were remarkably similar, though there is no information available about how the population may have changed during the intervening years.

The overall sparrow population has declined since 1992, and there has been no evidence of significant improvements (Table 1). In addition to the decline in overall numbers, the distribution has decreased. Several of the sparrow subpopulations have contracted toward the center of the remaining habitat patches (Cassey et al. 2007).

2.2. Factors Affecting the Species

2.2.1. Hydrology

The C&SF Project is a system-wide network of canals and water-control structures. The Corps and District operate the C&SF Project to achieve a variety of local and regional objectives including flood protection, water supply, and environmental benefits. Operations of the C&SF Project affect the hydrologic conditions of nearly all the wetland systems within south Florida to some degree, including the habitat supporting the CSSS.

The most critical issue facing the sparrow today is altered hydrology in what was once the largest and most productive subpopulation, CSSS-A. Since 1992, and coincidental with Hurricane Andrew, the numbers of dry nesting days and average annual discontinuous hydroperiod in this area have been inadequate to maintain suitable habitat conditions. This altered hydrology resulted from implementation of the C&SF project which re-routed the main flow through the Everglades from an eastern flow path within SRS to a more western one below the S-12 structures. The restoration of flow through the Everglades has been studied for decades and is a prominent part of the CERP, which has yet to be completed.

The Service's 2002 Biological Opinion prescribed IOP as an RPA with a requirement that included a hydrologic management regime to protect sparrow breeding by reducing water deliveries in western marl prairies which are too wet and increasing water deliveries to the eastern marl prairies that had been over drained.

Many areas of sparrow habitat have experienced vegetation change since monitoring was initiated. These changes in vegetative composition have resulted from changes in hydrologic conditions, fire frequency, and management actions. Over drying within CSSS habitat is a result of maintaining artificially low water levels within areas of sparrow habitat, such as those that occur along the eastern boundary of ENP, increasing the potential for woody vegetation encroachment, and reducing the suitability of the habitat for sparrow occupancy. Extended hydroperiods and deep water depths occur as a result of managed water releases in combination with wet-season rainfall which can lead to the marl prairie vegetation changing to marsh species, also reducing habitat suitability.

Under IOP, hydrologic management provided reduced flows to sparrow habitat located in the western marl prairies during the breeding season. Construction and operation of several detention areas adjacent to sparrow habitat in the eastern subpopulations increased hydroperiods by an average of approximately 40 days in some over-drained habitats such as CSSS-C. Many other routine hydrologic operations that occur throughout the C&SF system have resulted in changes to hydrologic conditions in and adjacent to sparrow habitat. Pre-storm and post-storm operations, testing of hydrologic management operations, and other similar activities conducted by the Corps and District also affect hydrologic conditions within sparrow habitat, mainly through alteration of the natural timing of wetting and drying events.

Appendix C details the findings of a draft preliminary report, Western Water Flows Recommendations Benefiting the Cape Sable Seaside Sparrow Subpopulation A. The report contains a history and background of the L-28 infrastructure, a discussion of associated hydrology, and short and long-term recommendations. Key points from this report include:

1) Investigations have implicated an additional, underestimated and uncontrolled source of water termed the Western Water Flows. Its source emanates from the L-28 Levee along the western boundary of WCA-3A, and specifically the western side of the levee canal. The L-28 Levee and L-28 Interceptor levees were built in the mid-1960s as major works of the C&SF Project. Their purpose was: 1) to store water in WCA-3, 2) to keep water on the Everglades side of the levee and off what was at the time private property (Big Cypress) which is now the BCNP, and 3) drain Big Cypress water southward. Fifty years later the basic hydraulics of the L-28 levee and canal network remains in place. Water in

BCNP is significantly diminished resulting in dry conditions and increased fire hazard, while excess water undesirably drains south impacting the western CSSS-A habitat.

2) The L-28 Interceptor diverts BCNP bound water to the southeast into WCA-3A. This has increased the depth and duration of high water and tree island flooding events in WCA-3A. It has also exacerbated the need to release water when demanded by operations through the S-12 structures, negatively affecting CSSS-A habitat.

3) The L-28 Levee undesirably drains water out of BCNP southward toward the western marl prairie (CSSS-A) in ENP.

4) The dual effect of the L-28 Interceptor and L-28 Levee has been to decrease the operational effectiveness of discharging water from WCA-3A through the S-12s. The L-28 Interceptor increases water levels in WCA-3A, whereas the L-28 Levee sustains a high water table in the S-12 tailwater even when those structures are closed, thus "keeping the pumps primed".

Western Water Flows are driven by the hydraulics of the L-28 Levee and L-28 Interceptor infrastructure (*i.e.* levees, canals, and structures). When the L-28 was constructed, BCNP was privately owned. The L-28 was designed to protect those areas from flooding and impound water in WCA-3A. This infrastructure has not been substantially changed since it was installed in the 1960s, the result of which has been over-drainage of water around and away from BCNP in favor of channeling the surplus water south (into WCA-3A and the western marl prairie). The CSSS-A has been negatively affected as a result. Absent changes to the L-28 system, Western Water Flows will continue to pose hydro-ecological impacts to the western marl prairie and CSSS-A.

2.2.2. Dry Nesting Days

While provision of the quality and quantity of viable habitat for all phases of the CSSS life cycle is vital, conditions during the March 1 to July 15 breeding season that favor successful rearing of young, and ideally multiple broods, are essential for maintenance of healthy and sustainable sparrow populations. This has been the subject of considerable study, and development of metrics and trigger levels in an attempt to foster these conditions. The CSSS Western Marl Prairie Reinitiation Trigger documented in the previous ERTP BO is worded as follows; "Fewer than 60 consecutive days with water levels below ground surface at NP-205 between March 1 and July 15 due to water releases in two consecutive years."

The goals of ISOP, IOP and ERTP were to keep CSSS subpopulations (particularly subpopulation A) dry during the breeding season and to also keep the habitat for subpopulations C, D, and F from excessive drying in order to prevent adverse habitat change and direct harm from increased fire frequencies. In the previous IOP Biological Opinion, a stage of 6.01 ft NGVD29 at NP-205 was established to provide a minimum of 40 percent of the habitat in CSSS-A to be dry for sparrow breeding. Analysis in the previous Biological Opinions also determined that, in order to maintain the population of CSSS-A, these dry conditions needed to occur for at least 60 consecutive days during the nesting season to facilitate one nesting cycle for breeding pairs in a majority of years.

Efforts to regulate the S-12 structures under ISOP, IOP, and ERTP to protect CSSS-A and its habitat west of SRS have resulted in an increase in the number of consecutive dry days (NP-205 stage below 6.0 ft) during the nesting season. Since the initiation of IOP, CSSS-A has experienced an average of 74 consecutive dry days, compared to the period preceding IOP beginning in 1990 which only experienced 39 consecutive dry days on average.

It was recognized in the 1999 Biological Opinion that there could be times when unseasonable rainfall events could overwhelm the ability of the water management system to provide the necessary dry conditions. Since implementation of the IOP in 1999, the minimum recommendations for protection of the sparrow in subpopulation A were not met in 2003, 2005, 2007, and 2010 (Table 2) (Corps 2010a). Since initiation of ERTP in 2012, the 60-consecutive-day metric has been met in every year except 2016, but this condition may not have occurred over 40 percent of the habitat in subpopulation A.

With the recent development of the Cape Sable Seaside Sparrow Viewer (Sparrow Viewer) tool (http://sofia.usgs.gov/eden/csss/index.php), it is now possible to conduct a broad analysis of the relationship of the NP-205 gauge to the spatial extent of habitat conditions (Table 3). Dates were selected throughout the period of record when the average daily stage at NP-205 was 6.0 ± 0.05 ft NGVD29 to determine the percent dry habitat in CSSS-A for those dates. The analysis of the Sparrow Viewer and the Everglades Depth Estimation Network (EDEN) stage data indicates that when the stage at NP-205 was approximately 6.0 ft, an average of only 24 percent of the habitat was dry, not 40 percent as previously expected (Figure 5). This analysis determined that an NP-205 stage of 5.41 ft NGVD29 would be necessary in order to achieve 40 percent of suitable nesting habitat within CSSS-A (Table 4, Figure 6). Based on this information, it can be concluded that the criteria included in previous biological opinions provided an insufficient amount of suitable breeding habitat during the IOP and ERTP to maintain a sustainable sparrow population in CSSS-A.

At the current NP-205 trigger level for CSSS-A of 6.01 ft, the 60 day criterion was met in 15 out of 26 years or 58 percent of the period of record. However, with the realization that the previous trigger stage overestimated the amount of dry habitat available a new assessment was made based on the Sparrow Viewer data. The required level of protection was only met in 8 out of 26 years or 31 percent of the period of record. These results indicate that the current level of breeding habitat has not been sufficient to aid in the recovery of the population within CSSS-A, and is only minimally adequate to maintain the subpopulation at a precariously low level.

One way to potentially improve the success of nesting and increase the number of broods fledged each year is to provide for a longer dry breeding season. The average nest cycle for sparrows is estimated to be 34 to 44 days (Pimm et al. 2002). A minimum of two successful nesting periods (≥ 80 days), in the majority of years is considered essential to maintain a stable and viable CSSS population (Pimm et al. 2002). This ≥ 80 day minimum criterion has been the standard previously used to benchmark the facilitation of multiple brood periods and some analysis in this report has been conducted with it, but it provides only the minimum time needed for two broods. Increasing this duration to at least 90 days provides additional time to account for delays in nest initiation due to weather conditions, possible reversals of water levels, and other factors which may delay or interrupt breeding attempts. By increasing the available breeding season from the previously specified metric of 60 days to at least 90 days the potential for a second and possibly even a third brood is substantially increased.

The requirement to provide suitable conditions over 40 percent of the habitat within CSSS-A, equating to approximately 24,000 acres, was originally established to ensure that sufficient habitat was properly maintained to support pre-1993 levels of sparrow populations. Over time, the western CSSS-A habitat has declined in condition due to extended hydroperiods. However, the Sparrow Viewer analysis has indicated that areas to the east of CSSS-A (Figures 7 and 8) appear to provide suitable breeding season dry periods, indicating that habitat management actions may provide benefits in that area. Given the currently diminished condition of both optimal CSSS habitat and population numbers compared to historical levels, and the need to identify what improvements in habitat would be possible to facilitate its recovery, it is appropriate to extend the analysis to determine the feasibility of expanding suitable habitat beyond the current boundary of CSSS-A.

2.2.3. Discontinuous Hydroperiod

The timing and extent of dry habitat during the Cape Sable seaside sparrow breeding season has been the subject of extensive research and analysis in an attempt to determine key periods and relationships to ensure successful breeding. However, equally if not more important, is the provision of optimal depth and duration of above ground surface water levels throughout each year (known as the discontinuous hydroperiod), and in an optimal occurrence frequency over the long range period of years to maintain a sufficient amount of suitable sparrow habitat capable of supporting a healthy sparrow population. Walters et al. (2000) observed that if water management produces long hydroperiods in CSSS habitat frequently enough to alter its vegetation, as has occurred in CSSS-A and CSSS-D, sparrow survival and reproductive rates will be moot because the habitat will be unable to support successful reproduction regardless of how many birds might be in the area.

The discontinuous hydroperiod for the marl prairie habitat type favored by CSSS has been determined to be in the range of 90-210 days (Ross et al. 2003, Beerens et al. 2016). Habitat in the lower end of this range or with less than a 90 day discontinuous hydroperiod tends to be more prone to fire and has more woody vegetation encroachment. Habitat in the upper range or with more than a 210 day discontinuous hydroperiod tends to quickly convert to habitat dominated by species such as sawgrass and cattail. Research has shown that habitat degradation, whether by changes in available habitat or increases in water level, had a much larger impact on final population size and quasi-extinction risk compared to changes in demography and behavioral parameters (Elderd and Nott, 2008).

In the past, the discontinuous hydroperiod analyses were based on data that were available from gauges situated within and in the vicinity of individual subpopulations. A single water-level gauge was used (in the case of NP-205, R3110 or EVER4) or several gauges within or in the vicinity of a subpopulation were used to estimate water depths in one or more subpopulation areas. Recently, several water-level gauges used to estimate water depths in CSSS habitats (MRSHOP-B1, MRSHOP-C1, MRSHOP-C2, and MRSHOP-C3 in CSSS-F and MRSHOP-D1 in CSSS-C) were discontinued following a reduction in funding. With the removal of these gauges and questions arising about the use of individual gauges to estimate hydrology over large areas, the Service worked with the USGS to develop an improved method for estimating and evaluating water depths and their spatial extent. EDEN has provided daily water-level and water-depth surfaces for the freshwater Everglades for the period 1991 to present. The Sparrow Viewer tool was developed by the USGS in coordination with the Service, to use these surfaces to estimate and evaluate water levels, depths, and durations in CSSS habitat on a near-real-time basis. CSSS Water-Depth Maps containing daily water depths based on the EDEN water-level surfaces, water-level gauge data, and ground elevation data are generated each day. The data have the same 400 meters by 400 meters grid resolution as other EDEN data. The animated viewer shows changes in water levels and provides calculations of the percent area that is dry along with other statistics relating to CSSS biology on a daily basis. Scientists and water managers can use the Sparrow Viewer data to spatially analyze and assess past and present impacts of hydrology on sparrow habitat and nesting success and develop management strategies for the future. Another tool developed by the USGS for use in analyzing EDEN data is the EDEN Transect Plotter tool, which facilitates the plotting of water levels from the EDEN daily water-level surfaces and ground elevations along transects located at key locations along water management features for specified periods such as the CSSS breeding season. This tool can be used to assess past events as well as providing a real time evaluation of hydrologic conditions. The tool has been used to evaluate conditions as a substitute for the MRSHOP gauges which were discontinued.

The following discussion incorporates both the gauge inferred hydrology and the Sparrow Viewer data and attempts to crosswalk the two to evaluate the conditions seen at the various CSSS subpopulations:

<u>CSSS-A</u>

Since 1993, the average annual discontinuous hydroperiod in CSSS-A has consistently been well above the optimal target. The NP-205 gauge, the indicator gauge for CSSS performance criteria for this subpopulation, has recorded the average annual discontinuous hydroperiod during the last ten years as 241 days. The average annual discontinuous hydroperiod across all gauges within CSSS-A over the last ten years has been 263 days, slightly less than the average over the entire period of record (285 days), (Table 5). Based on our climate analysis it appears that annual rainfall amounts have been decreasing at NP-205 since 2006 (Figure 9). Additionally, the area has not been affected by a large rainfall producing tropical storm or hurricane since 2006 indicating that the observed recent slight decrease in discontinuous hydroperiod may be the result of decreased rainfall and not necessarily operations. The Sparrow Viewer analysis demonstrates that CSSS-A had an average of only 9 percent of its acreage within the optimal discontinuous hydroperiod range during the period of record (1992-2015). During that period of record, CSSS-A only exhibited comparable conditions to the larger subpopulations in one year, 2008, when 35 percent of available habitat was in the optimal discontinuous hydroperiod range (Table 6). In 74 percent of the years it failed to meet the 90-210 day threshold over even 10 percent of the habitat.

CSSS-B

CSSS-B is presently the largest subpopulation in terms of numbers of sparrows and the second largest in area. The average annual discontinuous hydroperiod across all gauges during the 1992 to 2015 period of record has been 209 days and for the last ten years it has averaged 202 days. Subpopulation B has been consistently within the upper limits of the target discontinuous hydroperiod needed to maintain CSSS habitat (Table 7). The Sparrow Viewer analysis demonstrates that CSSS-B has been able to achieve the 90-210 day discontinuous hydroperiod threshold over 35 percent of its habitat. However, recently, it appears that CSSS-B may have experienced a decline in habitat meeting the threshold with 38 percent of the habitat meeting the threshold between 1992 and 2008 and 28 percent meeting it between 2009 and 2015. The decline from 2009 to 2014 is possibly due to wetter than average dry season conditions between 2012 and 2016 and/or the still to be determined effects of water management operations.

CSSS-C

CSSS-C is presently maintaining a very low population level and represents only a small portion of all delineated CSSS habitat. The eastern portion of this subpopulation has been subjected to overdrainage due to adjoining canal infrastructure resulting in the invasion of non-native woody vegetation and a frequent fire return rate. The western portion of this subpopulation has remained mostly unimpacted, except for occasional fires. Since the implementation of IOP, portions of this subpopulation have been affected to varying degrees by the construction and operation of infrastructure designed to retain more water in Taylor Slough and adjoining marshlands. The R3110 gauge, located in the northwestern part of CSSS-C, is used as an indicator gauge for operations relating to the C-111 Spreader Canal Phase 1 Project. The average annual discontinuous hydroperiod as indicated at R3110 over the period of record (1992 to 2015) has been 216 days. The average discontinuous hydroperiod, averaged across all gauges, over the 1992 to 2015 period of record has been 175 days. However, since 2009 both R3110 and the overall gauge average have consistently exceeded the target discontinuous hydroperiod with 243 days and 219 days respectively (Table 8). The Sparrow Viewer analysis (Table 6) demonstrates that between 1992 and 2008, CSSS-C had an average of 63 percent of its acreage in the optimal 90-210 day discontinuous hydroperiod range with 53 percent of the years achieving it over more than 60 percent of the habitat (Table 9). However, between 2009 and 2015 there has been a decrease in the area of habitat achieving the optimal range, possibly attributable to wetter meteorological conditions during the dry season (2012 through 2016) and/or the still to be determined effects of water management operations (Table 6).

CSSS-D

CSSS-D is also at a very low population level and represents only a small portion of all delineated CSSS habitat. There are four gauges that are located within the boundary of subpopulation D, three of which (CSSS-D1, CSSS-D2, and CSSS-D3) were installed as part of the environmental monitoring associated with the C-111 Spreader Canal Phase 1 Project, but only EVER4 has a sufficient record to make long term comparisons. The EVER4 gauge has been used as an indicator gauge for this subpopulation for operations relating to the C-111 Spreader Canal Phase 1 Project. Based on the EVER4 gauge records between 1990 and 2008, CSSS-D consistently averaged within the upper range of the target discontinuous hydroperiod needed to maintain CSSS habitat (average 204 days). Beginning in 2009 through present, the average discontinuous hydroperiod at the EVER4 gauge has increased to 253 days, consistently exceeding the target. Installation of additional gauges (CSSS-D1, CSSS-D2, and CSSS-D3) has greatly expanded the ability to evaluate habitat conditions within this subpopulation and the spatial extent of potentially suitable habitat. CSSS-D1 and CSSS-D2 are centrally located within habitat currently being utilized by the few sparrows remaining in this subpopulation. For the period of record available for these gauges (2011 to 2015), the average annual discontinuous hydroperiod has been 136 days, 181 days, and 310 days for CSSS-D1, CSSS-D2, and CSSS-D3 respectively (Table 10). CSSS-D3 has a longer discontinuous hydroperiod because it was placed midway between subpopulation D and the S-18C, where the C-111 Spreader Canal Project modelling indicated the largest effect from canal level changes would occur. The Sparrow Viewer analysis demonstrates that between 1992 and 2008, CSSS-D had an average of 45 percent of its acreage in the optimal 90-210 day discontinuous hydroperiod range (Table 6). However, the amount of habitat achieving the optimal range has decreased from 45 percent between 1992 and 2008 to 25.4 percent between 2009 and 2015 (Table 6). This is possibly attributable to wetter meteorological conditions during the dry season (2012 through 2016) and/or the still to be determined effects of water management operations.

CSSS-E

CSSS-E is presently the second largest population of CSSS. The average annual discontinuous hydroperiod across all gauges for the 1992 to 2015 period of record has been 206 days. Since the early 1990s, CSSS-E has consistently been within the target discontinuous hydroperiod needed to maintain CSSS habitat and its persistence is evidence of this (Table 11). The Sparrow Viewer analysis demonstrates that between 1992 and 2008, CSSS-E had an average of over 41 percent of its acreage in the optimal 90-210 day discontinuous hydroperiod range (Table 6). However, the amount of habitat achieving the optimal range has decreased from 41 percent between 1992 and 2008 to 33 percent between 2009 and 2015 (Table 6). This is possibly attributable to wetter meteorological conditions during the dry season (2012 through 2016) and/or the still to be determined effects of water management operations.

CSSS-F

CSSS-F has maintained a very low population level and has the smallest subpopulation area. In this case it appears that the over drained state of this subpopulation is the problem, frequently resulting in a discontinuous hydroperiod of less than 90 days. This subpopulation has been subjected to overdrainage due to adjoining canal infrastructure which has resulted in invasion of non-native woody vegetation, and an increased frequency of fire. The average annual discontinuous hydroperiod across all gauges during the 1992 to 2015 period of record has been

107 days, within the lower portion of the optimal 90-210 day range. Between the early 1990s and 2008, CSSS-F experienced an average discontinuous hydroperiod of 94 days, with many years below or barely within the lower range of the target discontinuous hydroperiod needed to maintain CSSS habitat. However, beginning in 2009, the gauge average increased to 145 days and has consistently been within the target discontinuous hydroperiod (Table 12). The Sparrow Viewer analysis demonstrates that CSSS-F has had an average of 26.1 percent of its acreage in the optimal discontinuous hydroperiod range over the period from 1992 to 2008 (Table 6). In 55 percent of those years it failed to achieve the target 90-210 discontinuous hydroperiod range over 25 percent of the habitat (Table 9). But more recently (2009-2015) there has been an increase in habitat in the optimal range. In five of the last seven years, conditions have improved such that this subpopulation has regularly met the discontinuous hydroperiod criteria with an average of over 51 percent of the habitat within the optimal range (Table 9), possibly as the result of wetter meteorological conditions during the dry season (2012 through 2016) and/or the still to be determined effects of water management operations.

<u>All Subpopulations</u>

The Sparrow Viewer results (Table 6) show that the percent of all subpopulations achieving the 90-210 day discontinuous hydroperiod varies annually from 8.5 to 63.0 percent and averages 27.8 percent over the period of record 1992 to 2008. During the period 2009 to 2015 the average percent of habitat with the 90-210 day discontinuous hydroperiod has decreased to 24.5 percent with a range of 12.4 to 53 percent. Generally, the larger and more stable subpopulations B and E, as well as the smaller subpopulation D have had 38 to 45 percent of their total available habitat in the target 90-210 day hydroperiod range during the period from 1992 to 2015.

2.2.4. Population Dynamics

The methodology used to estimate Cape Sable seaside sparrow population levels has remained consistent since 1981. Analyses conducted as part of the ERTP development, resulted in a population trigger level that was documented in the Service's ERTP Biological Opinion (Service 2010) that, when exceeded, required the Corps to reinitiate consultation. This reinitiation trigger was based on an average total population estimate of 3,145 birds over the 2001 to 2009 period, and specified that if the annual estimated population fell below one standard deviation (-230) of the average total population (3,145 - 230 = 2,915 birds) reinitiation of consultation under the Act was required. During the period of 2001 to 2016, the population estimate fell below the trigger level of 2,915 birds four times (2002, 2011, 2014, and 2016) (Table 1). Since this criterion was developed as part of the ERTP BO which was issued in 2010 with operations commencing after the ROD was signed in October 2012, only the exceedance that occurred in 2014 was considered as a trigger for reinitiation. Based on the Corps' proposal to continue operating under the current ERTP constraints, further exceedances can be expected in the near term due to effects from the continued ERTP operations along with influences from other factors including weather events, El Nino, and potential sea level rise.

An additional indication of the declining sparrow status can be seen in the decline in annual peak levels of the estimated population in CSSS-B and the total CSSS population from 1981 to present (Figure 10). Since sparrow population numbers are cyclic, often over a period of 3 to 4 years, related to both the average life span (Service 1999; Pimm et al. 2002), and weather and hydrologic conditions, a repeating pattern of high and low years can be discerned within the data. The high years are indicative of conditions that have been favorable for sparrow reproduction and survival when the population has been able to recover from previous poor years. If, as indicated by the declining peak population numbers, those favorable conditions are not resulting in substantial population increases, it is an additional indicator that the species is in need of additional management actions. Of further concern is that this decline also appears to be occurring in the largest remaining healthy subpopulation CSSS-B. Since 1992, the estimated populations in CSSS-A, CSSS-C, CSSS-D, and CSSS-F, have trended lower and remain at extremely low levels, an indication that little to no improvement is occurring in these subpopulations.

The South Florida Multispecies Recovery Plan (Service 1999), identified one of the recovery criteria components for the Cape Sable seaside sparrow as when the 3-year running average intrinsic rate of increase (*r*) for the total population is equal to or greater than 0 for at least 10 years. When r is greater than 0 it indicates an increasing population, and when r is less than 0 it indicates a declining population. From 1994 to 2004, the three year running average of r was greater than 0 in 6 years, and less than 0 in 4 years. Within the last 10 years (2005 to 2015), the three year running average of *r* was greater than 0 in 2 years, and less than 0 in 8 years (Figure 11). This metric is significant in that the calculation of the three year running average takes into account the complexity that is often introduced in trying to correlate yearly relationships. This metric provides additional evidence that population changes are connected to habitat effects which often occur over a period of years.

Pimm and Bass (2002), in their population viability analysis (PVA) of the sparrow offered the following tentative conclusion:

"the Cape Sable sparrow will survive only if it has at least three healthy subpopulations. To implement this requirement, the breeding areas west of Shark River Slough must not be flooded in the breeding season, and water levels should be raised in the northeast of Shark River Slough to reduce the incidence of fires." and further concluded:

"the population declines towards extinction within fifty years in the "plausible" scenario. It even goes to extinction in the "optimistic one". What if water were not released? The population dips below its population ceiling periodically, but persists indefinitely even in the plausible scenario."

"We predict that the Cape Sable sparrow subpopulation west of Shark River Slough will decline to extinction if the pattern of managed flows over the S-12 structures for the last 20 years is repeated."

Their study concluded that during the previous 20 years sparrow population levels had failed to recover from documented declines, and if similar water management operations were continued, their PVA analysis indicated that extinction was inevitable. In reviewing the progress in Everglades restoration, the status of the species since this analysis, and the effects of water management changes that have been implemented to date with consideration for the sparrow, the Service can find minimal justification to refute that conclusion.

A biased sex ratio has been observed by researchers conducting intensive ground surveys for the CSSS (Lockwood et al. 2006; Lockwood et al. 2007; Boulton et al. 2009a; Virzi and Davis 2013; Slater et al. 2014) (Table 13). The number of males observed in intensive ground surveys frequently exceeds the number of females observed, resulting in an increase in the sex ratio up to a maximum of 1.0. A male biased sex ratio is most often observed in smaller subpopulations (Slater et al. 2014), and may be a function of several factors such as habitat quality and increased female vulnerability to predation (Virzi and Davis 2013; Gruebler et al. 2009). Highly skewed adult sex ratios increase a species' risk of extinction (Dale et al. 2001; Donald 2007) and were observed during the extinction of the Dusky seaside sparrow, when ultimately all of the remaining sparrows in the wild were males (Delany et al. 1981). With this in mind, it is critical that the skewed sex ratio in small subpopulations be monitored closely to assess the rangewide status of the CSSS (Slater et al. 2014) and that actions be taken to address this issue.

Since the current population estimator assumes that there is a one to one ratio of males and females in the population and that they are paired and successfully reproducing, the resulting population estimate may be overestimating the total population. A proposed modification for the current population multiplier, adjusted for sex ratios observed within each subpopulation, results in a reduction in the population estimates by an average of 11 to 12 percent (Figure 12, Table 14). Of more concern is that the revised population estimates for some of the smaller subpopulations may be 25 percent lower than the current estimates. Further research is currently underway to increase the accuracy of the range wide survey methodology as well as the validity and statistical power of the current population estimate. However, the magnitude of the proposed adjusted population estimate (at least 11 to 12 percent lower) adds to the concern for the status of the CSSS population.

2.2.5. Territory Size

Another metric that has been used to evaluate the health of the CSSS population is the acres of suitable habitat available for each individual (Table 15). The larger, more stable subpopulations have fewer suitable acres per bird in the 90-210 day discontinuous hydroperiod range, meaning either the larger subpopulations have smaller territories covering the majority of the suitable habitat, and/or that the less stable subpopulations have a large amount of underutilized habitat. CSSS-B, the subpopulation with the largest population, had the lowest value for suitable acres per bird at 5.9 acres (2.4 ha) followed by CSSS-E, the second most populous, at 19.7 acres (7.9 ha). The number of suitable acres per bird in CSSS-A was substantially larger at 46 acres (18.5 ha), even though it has only averaged 9 percent of its potential acreage in the optimal target range. In 1992, the last year CSSS-A had a large population (2,608 birds), the average number of acres per bird in the target 90-210 day discontinuous hydroperiod range was 5.2 acres, comparable to CSSS-B. The smaller subpopulations, CSSS-C, CSSS-D, and CSSS-F, average 33 to 62 percent of their acreage within the target discontinuous hydroperiod range but account for very few birds which results in a high range of potentially suitable acres per bird (72 to 124 acres).

The average of the annual total number of suitable acres per bird across all subpopulations is 11.4 acres (4.60 ha), or 22.8 acres per pair (Table 15). This is larger than the territory size documented in Pimm et al. 2002, of 3.0 to 11.1 acres (1.2 to 4.5 ha) based on observations of known breeding pairs. This could be a further indicator of the current underutilization of the less optimal habitat by sparrows compared to usage in more optimal habitat areas studied by Pimm.

If 40 percent of the maximum acreage in CSSS-A were to exhibit the target discontinuous hydroperiod, this would provide approximately 24,000 acres of suitable habitat. This optimal habitat acreage area, at a theoretical average of 11.4 acres per bird, would result in a potential estimated population for CSSS-A of 2,100 birds. For comparison, the estimated population in CSSS-A in 1981 was 2,688 birds and as late as 1992 was 2,608 birds. Based on this analysis, 24,000 acres of habitat meeting the target 90-210 day discontinuous hydroperiod would provide sufficient habitat to begin restoring the overall population of CSSS-A to its previous level.

2.2.6. Vegetative Community Changes

Another factor affecting sparrows is the loss of suitable habitat due to extended flooding or high water levels. Sah et al. (2007) documented a conversion of habitat type from shorter hydroperiod plant species (less-flood tolerant) to those indicative of longer hydroperiod conditions (more flood-tolerant) not preferred by sparrows. In particular, vegetation in the wet prairies along the eastern edge of subpopulation E, the central part of subpopulation A, and the southern part of subpopulation B were indicative of wetter conditions. Based on vegetation studies within sparrow habitat, researchers concluded that the direction and magnitude of vegetation change within marl prairie depends on whether the vegetation is located along the fringes near either wetter or drier areas, and the magnitude of the hydrologic change that is influencing them (Ross et al. 2003, 2004, 2006; Sah et al. 2007, 2010, 2013; Elderd and Nott 2008). The transition from one vegetation type to another (*e.g.*, prairie to marsh) in response to hydrology may take place in as little as 3 to 4 years (Armentano et al. 2006); however, the transition from marsh back to suitable prairie may take longer (Ross et al. 2006; Sah et al. 2010, Sah et al. 2013).

Vegetation change is also influenced by the interaction of fire and hydrology. Studies by Sah et al. (2010) revealed that not only did post-fire flooding delay the vegetation recovery process, but also caused it to follow a different trajectory in terms of species composition. This could potentially impede recolonization of previously burned areas by the sparrow (Sah et al. 2010).

Vegetation studies within sparrow habitat (Ross et al. 2004) showed that sparrows occupy prairies with a hydroperiod ranging between 90 and 240 days. In sites with hydroperiod ranging between 150 and 240 days, CSSS occupancy was over 40 percent, while at shorter and longer hydroperiods occupancy was 20 percent or less (Ross et al. 2004). This Biological opinion uses

210 days as the upper limit of the discontinuous hydroperiod metric for the analysis of effects. However, solely attaining this hydroperiod requirement may not be enough to promote a transition from marsh to prairie habitat, as this process likely requires a fire frequency regime in the landscape defining process (Ross et al. 2006; Sah et al. 2010).

Water management operations associated with IOP and ERTP have not resulted in an adequately shortened annual hydroperiod sufficient to maintain suitable marl prairie habitat throughout the historical expanse of subpopulation A. This is especially evident in the lower-elevation peripheral portions of subpopulation A (*e.g.*, at the P-34 gauge) where the average annual hydroperiod ranges from 235 to 320 days. The extended hydroperiods and associated habitat degradation are likely contributing to the decline of the sparrow in subpopulation A and suggests a source of water to the west of the S-12s which needs to be investigated. It is not precisely known where, when, or how this "additional" water reaches the P-34 gauge but it has been hypothesized that it may be coming from the infrastructure associated with the L-28 Borrow Canal, or may be the early impacts of sea level rise. Consequently, subpopulation A has not recovered under IOP or the subsequent ERTP, nor has it been extirpated, but the estimated population has remained extremely low compared to the level that existed in 1981 and 1992.

Based on modeling results associated with recent projects (*i.e.*, C-111 Spreader Canal), subpopulation C was expected to experience increased discontinuous hydroperiod on 1,320 acres during a wet year, improved hydroperiod on 1,442 acres during an average year and no change in hydroperiod in a dry year. Subpopulation D was expected to experience increased hydroperiod with approximately 1,606 acres having an inundation duration longer than 180 days. However, none of the acreage was expected to extend beyond a 192-day hydroperiod, with the greatest change (875 acres) being from 152 to 183 days. The sparrow's ability to feed, breed and shelter was expected to be reduced but not eliminated and the changes were not expected to render the habitat unsuitable or unusable by sparrows. At the time, sparrow research indicated that a discontinuous hydroperiod metric of 60 to 180 days was optimal (Armentano 2006). Subsequent studies and analyses have shifted this forward 30 days to a 90-210 day discontinuous hydroperiod (Ross et al 2003). This change was to prevent the habitat from being too dry and to accommodate that fringe hydroperiod, 180 to 210 days, which was more optimal for scattered sawgrass that sparrows will often use.

To address the possible impacts, the C-111 Spreader Canal Project team developed a Habitat Improvement Plan which provided the conceptual framework for improving up to 1,600 acres of habitat for the sparrow in and around subpopulation D (SFWMD 2010). This plan was recently updated (SFWMD 2014). The plan has been implemented, with the first phase being woody vegetation removal and control in the northern portion of CSSS-D critical habitat.

Limited data are currently available on the effectiveness of the Habitat Improvement Plan since the completion of construction and commencement of C-111 Spreader Canal Project operations in 2012. Three additional gauges CSSS-D1, CSSS-D2, and CSSS-D3 (Table 10) were installed in key habitat locations in 2011 as part of this effort. Data from an existing gauge, EVER4, are also available within CSSS-D since 1990. The SFWMD began operation of the S-199 and S-200 pumps early in the wet season (July) in 2012. Based on data available since these operations commenced, discontinuous hydroperiod has averaged 210 days across CSSS-C (Table 8), and 245 days based on EVER4 in CSSS-D (compared to an average of 222 days across all four available gauges) (Table 10).

For comparison, discontinuous hydroperiod during the period 1992 through 2011 averaged across all gauges in CSSS-C was 166 days and based on EVER4 in CSSS-D was 215 days. This resulted in an increase in average hydroperiod in CSSS-C of 70 days and 47 days in CSSS-D since project operations commenced. In terms of acreage meeting the current 90-210 day discontinuous hydroperiod target, an average of 5,155 acres in CSSS-C and 4,615 acres in CSSS-D met the target during the 1992 through 2011 period, but only 3,252 acres in CSSS-C and 2,162 acres in CSSS-D met it during 2012 through 2015. This indicates a reduction of 1,903 and 2,453 acres respectively, meeting the 90-210 day optimal discontinuous hydroperiod target.

Initially, this data would seem to indicate that expected impacts of the C-111 Spreader Canal Project were underestimated and that operation of the project may have resulted in greater habitat impacts in terms of discontinuous hydroperiod in CSSS-C and CSSS-D than modeling results indicated. However, this observation needs to be tempered with the realization that only a short period of record post initiation of project operations is available (2012 to 2015) and that 2012 and 2013 were extremely wet years. Further monitoring of the effects needs to be completed in order to fully assess the impacts of the C-111 Spreader Canal Project on hydrology in these subpopulations.

2.2.7. Construction, Maintenance and Human Disturbance

Since ERTP-2016 is a continuation of the current operations, and no construction is proposed, there will not be any direct impact due to project related construction. While direct physical disturbance to sparrow habitat and disturbance resulting from construction activities has occurred in the past, it has been limited because nearly all available sparrow habitat occurs within ENP and other conservation lands. Indirect effects of construction activities have included noise and vibration disturbance from heavy earth moving equipment and a general increase in human presence in the project area. Construction and maintenance of roads, canals, and levees near sparrow habitat have likely resulted in some localized effects to sparrows through loss or degradation of habitat or disturbance. However, maintenance and human disturbance is an ongoing issue that the Service has been attempting to address with its partner agencies. Maintenance of monitoring gauges has resulted in the destruction of habitat through the creation of paths between access points and the gauges. These paths can disrupt surface flow and may aid in spreading invasive plants or providing trails for exotic animals to access parts of the habitat.

2.2.8. Fire

Fire is a natural or human-related factor that affects marl prairies occupied by the sparrow and most sparrow habitat has burned at some point during the past 30 to 40 years. ENP, BCNP, and the FWC have all conducted prescribed burns within sparrow habitat on lands within their respective jurisdictions. Fire management on DOI land (ENP and BCNP) combines fire operations, prescribed fire, and fire ecology in order to maintain fire in the natural ecosystems while considering impacts on nearby human population centers as well as threatened and endangered species habitat. The Service has consulted with ENP and BCNP on several fire management plans and has issued a biological opinion on ENP's 2015 Long-Term Fire Management Plan (NPS 2014). The Service also participates in the annual sparrow/fire symposium held at ENP by their fire management staff. In addition, these agencies and the Florida Division of Forestry conduct wildfire suppression and management within sparrow habitat.

In the short-term, fire typically renders sparrow habitat unsuitable for occupancy, because it removes the vegetation that sparrows rely upon for cover and refugia especially during the breeding season. Following fire, vegetation normally begins to regenerate rapidly and reaches pre-burn density and species composition about 2 years later. Sparrows do not regularly occupy burned areas for 2-3 years after fire (La Puma et al. 2007). ENP has conducted prescribed fires in former sparrow habitat within the western marl prairies to facilitate habitat restoration and has conducted wildfire suppression within CSSS-B, with the intent to reduce potential impacts to sparrows and sparrow habitat. Additionally, prescribed burns have been conducted along the eastern ENP boundary to reduce the likelihood of human-ignited fires spreading into sparrow habitat near subpopulations C, E, and F. Fires, prescribed, natural, and human-ignited, have occurred within and in the vicinity of subpopulation D. Because fires reduce habitat suitability for up to 3 years, it can have adverse effects on sparrow populations, but also may be necessary in the long-term for the maintenance of habitat (Taylor 1983; Pimm et al. 2002; Lockwood et al. 2003, 2005; LaPuma et al. 2007).

Several fires burned within sparrow habitat during the 2008 dry season. Among these were the West Camp Fire (CSSS-A) and Mustang Corner Fire (CSSS-E and CSSS-F), which was the largest fire to have burned in ENP since the Ingraham Fire in 1989. Unlike previous burned areas, pre-fire vegetation data were available for these fires and Sah et al (2010) provide a preliminary evaluation of one year after the fire. Post-fire hydrology in these areas was favorable for normal recovery with a gradual increase in water depth. This is in contrast to a subset of sites burned in 2005 that were flooded within 7 to 14 days of the fires, and remained significantly different from pre-burn vegetation composition even four years post fire. More recently in 2015, the Dogwood, Otter, and 10 Mile Fires burned a total of approximately 3,350 acres, and in 2014 ENP conducted the River of Grass NW prescribed burn, which covered approximately 8,750 acres. These fires were within or in close proximity to subpopulation A habitat. The 10 Mile Fire burned occupied sparrow habitat in southwestern CSSS-A during 2015 and subsequently no sparrows were detected in that area during the 2016 surveys. Based on previous experience with burned areas, we would expect that conditions could be unsuitable for CSSS for the next 2 years in this area. This further increases the importance of providing hydrologically suitable areas in the northern part of CSSS-A which are most directly impacted by S-12 flows. Although habitat changes caused by these fires have not been monitored closely, they are part of a revised ENP fire management strategy that is structured to protect sparrows and improve sparrow habitat conditions.

Small populations are particularly at risk from a catastrophic event or series of events, such as fire or major rainfall during the breeding season. About two-thirds of the total CSSS population currently occur within subpopulation B, which has remained relatively stable. However, if a large fire or other catastrophic event were to occur in this subpopulation, there is a possibility the entire remaining CSSS population could be reduced by 60 percent or more.

2.2.9. Introduced Predators

The introduction of exotic species has been problematic in South Florida for many years. The Burmese python (*Python molurus bivittatus*) is found widely throughout South Florida and especially concentrated in ENP, Southern Glades, and the Model Lands where it is having major adverse effects on those ecosystems. Burmese pythons now number in the thousands if not tens of thousands in ENP and are known to consume a wide variety of prey (Snow et al. 2007), including small birds. There is documented overlap of Burmese python populations and sparrow subpopulations (Hart et al. 2015).

A more recent introduction, the Argentine black and white tegu (*Salvator merianae*), is also a concern. The tegu is a large omnivorous lizard which has been experiencing a population explosion in the Model Lands located to the east of ENP. Sightings of this species, as well as other tegu species, have been made within the critical habitat designated for CSSS-C and CSSS-D. As tegus outgrow their juvenile state they begin to move towards a higher protein diet, frequently scavenging eggs from other reptiles, and even eating small birds. It is possible that as this exotic species continues to expand its range it may become a significant predator for CSSS (Mazzotti et al. 2014, Mazzotti 2015). While neither species has yet been documented depredating the CSSS, both species represent major threats as a predator, and are now an established part of the environmental baseline (Figure 13).

2.2.10. Climate Change

Climate change and sea level rise represent significant short- and long-term threats to the environmental baseline of CSSS and their habitat (Appendix D). Sea level rise has been estimated by various sources to potentially increase by as much as 12 to 48 inches by the end of the century (National Climate Assessment [NCA] 2014; Rahmstorf 2007; Pfeffer et al. 2008). Because the entire population of CSSS occurs in low lying areas in south Florida, the population may experience changes in habitat conditions or availability due to climate change and sea level rise over the next several decades (Figures 14, 15, 16).

Modeling scenarios provided by the Corps for South Florida at the +1, +2, and +3 ft above mean higher high water (MHHW) levels indicate that subpopulations A, B, and D are particularly vulnerable, even in the lower end of these scenarios. The baseline model scenario indicates that these areas may already be experiencing detrimental habitat effects (Figure 17). Based on the Corps' model projections, a sea level rise of only 1-foot MHHW could result in a loss of approximately 40 percent of subpopulation A and 60 percent of subpopulations B and D. If sea levels were to rise 2-feet MHHW, it could result in a loss of almost 60 percent of subpopulation A and nearly 100 percent of subpopulations B and D. In the long term, all subpopulations could potentially experience major flooding effects, and if the CSSS is to be saved as a species, accommodations for expanded habitat or relocation of individuals will need to be considered.

The Service will continue to monitor sea-level rise and other effects of climate change closely under the Strategic Habitat Conservation (SHC) paradigm. SHC is an adaptive, science-driven process that begins with explicit species population objectives in a framework for adjusting management strategies in response to monitoring, data and assumption-driven research, including new data about climate change (Service 2006b).

2.2.11. El Nino

Wetter than average conditions due to predicted El Nino effects prevailed in South Florida through the end of 2015 and the first half of 2016, encompassing the 2016 CSSS breeding season (Figure 18). Additionally, the 1998 and 2002-2003 period was also considered to be strongly influenced by the El Nino effect (Figure 19). These El Nino events have a significant effect on the acreage of CSSS habitat that is in the 90-210 day discontinuous hydroperiod range compared to non-El Nino years (Table 16). Only CSSS-C and CSSS-D achieved the desired 90-210 day range over sufficient habitat during El Nino years. The amount of habitat meeting the 90-210 day threshold in CSSS-A was extremely low, with only 0.7 and 6 percent of the habitat achieving it during 1998 and 2003, respectively. The occurrence of El Nino conditions resulted in a major short-term negative effect on the environmental baseline for CSSS habitat in 2016 because of the wetter conditions.

2.2.12. Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication), portions of the Everglades have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species. Sah et al. 2013 observed; "In the Taylor Slough basin, surface water entering ENP typically has low average phosphorus content (10µg/l), (Sutula et al. 2001), *i.e.* within the range considered to be protective of oligotrophic Everglades habitats. However, the cumulative effects of phosphorus loading in outflows from the canal (L31N/C-111) seem to have enriched adjacent soils in Taylor Slough (Surratt et al. 2012), resulting in a change in plant species composition."

Increased production and changes in the periphyton (freshwater organisms clinging to plants and other objects projecting above the bottom sediments) result from increasing water levels, longer hydroperiods (Browder et al. 1994), or from nutrient enrichment (McCormick and O'Dell 1996). During high water events, submerged periphyton mats can become floating mats and shade out submerged macrophytes (Van Meter-Kasanof 1973). Field observations suggest that as heavy floating periphyton mats dry they can flatten and kill the aboveground portion of muhly grass and other vulnerable species. In contrast, sawgrass can penetrate this thick mat. Pimm et al. (2002), noted that an area spanning several kilometers dominated by mixed prairie was covered by such a mat after waters receded in 1996, which left few places for sparrows to nest during the following breeding season, and thereafter supported a smaller breeding population.

How continued implementation of ERTP may effect water quality is difficult to predict and assess. An interagency meeting of the Technical Oversight Committee on October 19, 2010, included a discussion of a spectrum of potential water quality impacts of ERTP (Shafer, 2010; Surratt, 2010) that failed to reach a consensus about the magnitude of such impacts. However, given our present understanding of operational effects of the current water management infrastructure, and concerns expressed by researchers about the potential consequences of higher phosphorus levels, future vigilance is warranted.

2.2.13. Methylmercury

Since the late 1980s , researchers have documented the upper trophic-level biota in the Everglades as being highly contaminated with mercury (Hg), with measured concentrations from feather samples of longer-lived wading birds such as anhingas, ibis, and egrets (Frederick et al. 2004, Herring et al. 2009). Fish consumption advisories have been issued for the Everglades due to high Hg levels within species such as largemouth bass (*Micropterus salmoides*). In wetland systems, mercury contamination is particularly harmful as inorganic mercury under certain conditions is microbially converted to methylmercury (MeHg), which can accumulate as it moves up the food chain. This has been hypothesized as one reason for documented declines of Everglades bird species. Cleckner et al. (1998) found spatial variability with higher concentrations of MeHg occurring in the southern portions of WCA-2 and WCA-3 in the Everglades. Their studies also found that fish and hemipterans had the most MeHg and the magnitude of accumulation in biota varies seasonally and often independently of water concentration.

Monitoring of Hg levels has been conducted in birds based on blood, feather, and egg samples. Mercury concentrations can vary widely depending on the sample source material. Herring et al. (2009) found that feather growth influences blood mercury levels, and that nestlings were buffered to some degree against the adverse effects of mercury during early growth periods, because mercury is sequestered in growing feather tissues. Upon completion of feather growth, this elimination pathway is closed. Condon and Cristol (2009) found that the highest risk period for mercury intoxication in young songbirds may occur during the vulnerable period after fledging, when rapidly growing feathers no longer serve as a buffer against dietary mercury. Interestingly, Brasso et al. (2010), found that when female tree swallows lay eggs, some of the body burden of mercury was eliminated into each egg, potentially leading to declining mercury across the clutch.

Jackson et al. (2011) found up to 34 percent reduction in nesting success in Carolina wrens along the forest floodplain of two mercury contaminated rivers in Virginia. This study also reported a range of effects concentrations associated with various levels of reproductive impairment. A 10 percent reduction in nest success corresponded with 0.7 μg/g mercury in the blood, 2.4 μg/g mercury in body feathers, 3.0 μg/g mercury in tail feathers, and 0.11 μg/g mercury in eggs. This study shows that songbirds can suffer negative reproductive effects at relatively low mercury concentrations. Krabbenhoft (pers. comm. 2008), reported mercury concentrations for Cape Sable seaside sparrows in the Everglades, based on juvenile and adult feather and egg samples collected in all subpopulations, as 0.7 to 2.5 µg/g in feathers and 0.1 to 0.45 µg/g in eggs, consistent with the levels Jackson et al. (2011) observed to reduce nest success.

2.2.14. Conservation Actions by Others

The Department of Interior (NPS, USGS and Service) has developed a Memorandum of Understanding (MOU) outlining actions that are intended to benefit the CSSS (Service 2015). The MOU includes actions such as habitat management, research on population trends and estimates, improved information on genetics, and preparing for the potential need for captive breeding and translocation. Recently developed tools, including habitat suitability models and the Sparrow Viewer, substantially improve assessment capabilities. These tools are being used to evaluate conditions on a near real time basis in order to inform water management decisions.

ENP recently consulted with the Service on a long-term fire management plan designed to improve habitat conditions for the CSSS and other species within the Park. ENP also consulted on a land swap for the relocation of an FP&L powerline right-of-way. This land swap is expected to allow for the movement of water into the historic sloughs and result in improved hydrologic conditions within the Park.

ENP is preparing for the removal of the old Tamiami Trail and backfill of the borrow canal. This action is expected to protect CSSS-A from backwater effects caused by flows from S-12C/D. The 2010 ERTP BO evaluated replacement of the existing culvert in the old Tamiami Trail borrow canal with a plug. CEPP evaluated removal of the old Tamiami Trail roadway but did not include backfill of the adjacent canal. Land acquisition by DOI is also moving ahead at an expedited pace to prepare for the eventual increase in operating stage of the L-29 Canal.

Earlier in 2016 the SFWMD performed an emergency construction action and rehabilitated 6 plugs in the L-28 Canal. It is widely thought that the L-28 Canal contributes to the increased flows along the western side of CSSS-A (Appendix C). The placement of these plugs was intended to allow for the use of S-344 to reduce high water in WCA-3A, reduce flows over CSSS-A, and provide additional water to Big Cypress National Preserve.

The actions described above, along with others, are expected to improve habitat conditions in the upcoming years and thereby improve the outlook for the sparrow.

2.3. SUMMARY OF SPECIES STATUS

2.3.1. Population Dynamics

- Peak CSSS-B population estimates and the total population estimates have steadily decreased, and smaller subpopulations have not recovered.

- Compared to the period 1994-2004, the intrinsic rate of increase (r) for the last ten years (2004-2014) indicates a declining population.

- The minimum population level of 2,915 sparrows has been exceeded three times since 2010 (2011, 2014 and 2016).

- A biased sex ratio is frequently observed by researchers conducting intensive ground surveys for the CSSS. Using observed sex ratios in revised calculations of the estimated population results in a population estimate 11 to 12 percent lower than what is currently estimated.

2.3.2. Habitat Characteristics

- For optimal CSSS habitat, the desired discontinuous hydroperiod target range is 90 to 210 days.

- Subpopulation A has consistently exceeded the target discontinuous hydroperiod needed to maintain CSSS habitat and the population has continued a steady decline while subpopulations B and E have been consistently within this target and have maintained relatively stable populations.

- Subpopulations C and D since 2009 have consistently exceeded the target discontinuous hydroperiod range and population estimates have remained relatively low.

- Since ERTP-2016 isn't proposing significant changes to the current operations, it is expected to continue this pattern of longer than desired hydroperiod in subpopulations A, C, and D.

- The larger subpopulations have consistently had 30 to 40 percent of their total available habitat in the target hydroperiod range compared to only 10 percent for subpopulation A.

- Subpopulation A, the largest of the subpopulations in terms of area, includes 41 percent of all currently delineated CSSS habitat and has the greatest potential for effecting CSSS recovery.

2.3.3. Breeding conditions

- Analyses reveal that less breeding habitat has been available in CSSS-A than originally assumed.

- A minimum of two successful nesting periods (≥90 days), in the majority of years is considered essential to maintain a stable and viable CSSS population. However, the past and present operating regime has only been able to achieve ≥ 90 consecutive dry nesting days over 40 percent of CSSS-A in 3 out of 26 years (11 percent) of record.

- Data indicate that on average 60 or less consecutive dry days does not sustain a viable CSSS population.

2.3.4. Other Threats

- Based on Sparrow Viewer output, additional potential CSSS habitat may exist east of CSSS-A as indicated by the presence of dry habitat during the breeding season and should be investigated.

- The southern and western portion of CSSS-A have consistently exhibited wet conditions throughout the 1990 to 2015 period of record and unless major changes are made to factors affecting this area, it may not be able to be restored.

- Sea level rise represents significant short and long term threats to the environmental baseline of CSSS habitat range wide. Subpopulations A, B, and D are particularly vulnerable to sea level rise in the near term and may already be experiencing detrimental habitat effects.

- In the long term, all subpopulations will potentially experience major flooding effects due to sea level rise and if the CSSS is to be saved as a species, accommodations for expanded or relocated habitat will need to be considered.

2.3.5. Hydrology

- The most critical issue facing the sparrow today is altered hydrology in what was once the largest and most productive subpopulation, CSSS-A.

- The Service's 2002 Biological Opinion prescribed IOP as an RPA to the Service's 1999 Jeopardy Biological Opinion, with requirements which included a hydrologic management regime to protect sparrow breeding by reducing water deliveries in western marl prairies which are too wet and increasing water deliveries to the eastern marl prairies that had been over drained.

- Over dried habitat is subject to woody vegetation encroachment which reduces the suitability of the habitat for sparrows.

- Extended hydroperiods and deep water depths can result from managed water releases in combination with wet-season rainfall, causing vegetation changes from marl prairie species to marsh species, resulting in reduced habitat suitability.

- Under IOP, hydrologic management appeared to provide reduced flows to sparrow habitat located in the western marl prairies during the breeding season.

- Construction and operation of several detention areas adjacent to sparrow habitat in the eastern subpopulations increased hydroperiods by an average of approximately 40 days in some over drained habitats such as CSSS-C.

- Investigations have implicated an additional, underestimated and uncontrolled source of water termed the Western Water Flows. Its source emanates from the L-28 Levee along the western boundary of WCA-3A, and specifically the western side of the levee canal. The L-28 Levee and L-28 Interceptor levees were built in the mid-1960s as major works of the C&SF Project.

- Western Water Flows are driven by the hydraulics of the L-28 Levee and L-28 Interceptor infrastructure (*i.e.* levees, canals, and structures). This infrastructure has not been substantially changed since it was installed in the 1960s, the result of which has been over-drainage of water around and away from BCNP in favor of channeling the surplus water south (into WCA-3A and the western marl prairie). The CSSS-A has been negatively affected as a result. Absent changes to the L-28 Levee and L-28 Interceptor, Western Water Flows will continue to pose hydro-ecological impairment to the western marl prairie and CSSS-A (Appendix C).

2.3.6. Fire

- Fire is a natural or human-related factor that affects marl prairies and most sparrow habitats have burned at some point during the past 30 to 40 years.

- In the short-term, fire typically renders sparrow habitat unsuitable for occupancy because it removes the vegetation that sparrows rely upon for cover and refugia especially during the breeding season. Following fire, vegetation normally begins to regenerate rapidly and reaches pre-burn density and species composition about two years later.

- ENP, BCNP, and the FWC all conduct prescribed burns within sparrow habitat on lands within their respective jurisdictions. Fire management on DOI land (ENP and BCNP) combines fire operations, prescribed fire, and fire ecology in order to maintain fire in the natural ecosystems while considering impacts on nearby human population centers as well as threatened and endangered species habitat.

- The Service has consulted with ENP and BCNP on several fire management plans as well as participates in the annual sparrow/fire symposium held at ENP by their fire management staff. In addition, these agencies and the Florida Division of Forestry conduct wildfire suppression and management within sparrow habitat.

2.3.7. Invasive and Exotic Species

- Invasive plant species such as melaleuca, Australian pine, Brazilian pepper, and other woody species can become established in sparrow habitat and reduce habitat suitability.

- Management of invasive woody plants has been conducted by ENP, FWC, and the SFWMD in and adjacent to sparrow habitat to improve habitat suitability. Herbicide treatment of large stands of exotic trees has reduced the spread of these species and has improved sparrow habitat in some areas. These invasive plant species regenerate rapidly requiring continued maintenance controls.

- Burmese pythons and the black and white tegu have become established in sparrow habitat and have the potential to depredate sparrows. Efforts to remove invasive exotic animals like the Burmese python and tegu have been initiated, and more recently intensified, but both species appear to have become established and are expanding their occupied habitat area (Figure 13).

2.3.8. Construction, Maintenance and Human Disturbance

- Since ERTP-2016 is a continuation of the current operations, and no construction is proposed, there will not be any direct impact due to construction.

- Maintenance and human disturbance is an ongoing issue that the Service has been attempting to address with its partner agencies. Maintenance of monitoring gauges has resulted in the destruction of habitat through the creation of paths, either from foot traffic or from off road vehicles, between access points and the gauges. These paths can disrupt surface flow and may aid in spreading invasive plants or providing trails for exotic animals to access parts of the habitat.

2.3.9. Water Quality

- The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen.

- Major portions of the Everglades have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species.

- Increased production and changes in the periphyton resulting from increasing water levels and longer hydroperiods, or from nutrient enrichment may produce heavy floating periphyton mats that can flatten and kill the aboveground portion of muhly grass and other vulnerable species resulting in fewer places for sparrows to nest.

- The increased risk of habitat change resulting from continued implementation of ERTP is difficult to predict and assess. However, given our experience with operation of the majority of the system that has been constructed and concerns expressed by researchers about the consequences of potential higher phosphorus levels, future vigilance is warranted.

2.4. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of listed species, their habitat (including designated critical habitat), and ecosystem within the action area. It is a "snapshot" of the species' health and critical habitat conditions in the action area at the time of the consultation, and does not include the effects of the action under review.

Since the action area includes the entire range of the CSSS there is no difference between the status of the species in the action area and the status of the species. Refer to the prior Status of the Species section for details.

2.5. EFFECTS OF THE ACTION

This section addresses the direct and indirect effects of the Action to the CSSS, including the effects of interrelated and interdependent activities. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

2.5.1. Direct Effects

The evaluation method used to assess the effects of ERTP on the CSSS in the 2010 BO was similar to that outlined in the 1999 Biological Opinion on the MWD Project, the Experimental Program, and the C-111 Project and primarily utilized SFWMM modeling. SFWMM version 5.5.2.2 with a 36-year period of record from 1965 to 2000 was used to evaluate ERTP alternatives with results reported in the BA (Corps 2010a). Additionally, observed data recorded at the monitoring site NP-205 during the operation of ISOP, ISOP 2001, and IOP were compared to model predictions. The effect of ERTP on sparrows was determined to be completely hydrologic since the structural features within the project area were already completed under the IOP. These effects were discussed in the associated Biological Opinion for the ERTP action at that time (Service 2010).

The proposed action being evaluated in this Biological Opinion is the continuation of ERTP operations. Hydrologic conditions predicted by the model for the 2010 ERTP Biological Opinion were expected to maintain the CSSS population, but the species has continued to decline. The Service has reviewed the Corps' annual assessments (Corps 2011 b, 2012, 2013, 2014, 2015) in analyzing the effects of ERTP actions. Hydrologic impacts to sparrow nesting and sparrow habitat have been documented as part of the analyses in these reports, and are expected to continue until the proposed CERP projects are implemented and additional operational flexibilities are available. The continued operation under the ERTP is not expected to significantly decrease the frequency or intensity of previously documented impacts in the near term.

Hydrologic performance for the CSSS has previously been evaluated based on stages at specific gauges. The current ERTP-2016 BO is considering a modification to the evaluation method used to assess hydrologic effects on the CSSS. We now propose to use the Sparrow Viewer to provide regional and subpopulation-specific views of hydrologic conditions in near real time. The Sparrow Viewer reduces the reliance on single gauges, such as NP-205, and displays results based on hydrologic surfaces over the entire range of the species. One example of how this new evaluation method has improved our understanding of the effects of the project on the species can be seen by comparing the NP-205 output with the Sparrow Viewer output. It was previously believed that a stage of 6.01 ft NGVD at NP-205 would result in 40 percent of CSSS-A being dry. The Sparrow Viewer demonstrates that this stage only provided dry conditions over approximately 25 percent of the habitat, much less than what was expected.

Managed water releases through the S-12 structures and the S-343A and B structures have a direct effect on the hydrologic condition within CSSS-A, which is located immediately downstream from these structures. These structures have varying effects on the hydrology in sparrow habitat which is reflected in the hydrologic modeling as well as in actual practice. As an example, the S-12A structure gates were partially opened due to high water in WCA-3A during the 2016 CSSS breeding season to prevent overtopping of the structure. S-12A gate was opened to allow the equivalent amount of water that would have otherwise been released by overtopping in accordance with the 2012 Water Control Plan. Uncontrolled overtopping of the structure could have resulted in risk to the integrity of the structure. A noticeable increase in groundwater and surface water was detected five days later at NP-205. However, the individual effects of each structure on hydrologic conditions in the area have not been well established through field measurements. The S-12A structure has been assumed to have the greatest direct influence on hydrologic conditions within sparrow subpopulation A due to its location immediately upstream of CSSS-A, followed by S-12B, C and D to a lesser extent. Additionally, it is clear that construction and operation of the C&SF project has diverted the historic flow path to the west, significantly increasing the amount of water in the vicinity of the S-12 structures and CSSS-A. For these reasons, and because ERTP-2016 relies on the operations of the S-12 structures, we have concentrated much of our evaluation on the effects of the proposed project on CSSS-A.

2.5.1.1. *Cape Sable Seaside Sparrow Evaluation Criteria*

2.5.1.1.1. Nesting Criteria

Sparrows nest close to the ground surface with an average early season height of 6.3 inches and 8.3 inches later in the nesting season when water levels begin to rise (Lockwood et al. 2001). Water levels that rise above ground surface within occupied sparrow habitat, as a result of natural rain events or water management operations, may cause nest flooding and failure, increased predation, and a period of mating inactivity (male sparrows stop singing) which may reduce nesting success (Nott et al. 1998; Boulton et al. 2007; Baiser et al. 2008).

One important hydrologic measure of the potential for CSSS nesting success is the number of consecutive days between March 1 and July 15 (total of 137 days) that water levels are near or below ground surface. The nesting season range of dates used incorporates roughly 84 percent of the time frame between the earliest and latest recorded nests (Pimm et al. 2002), and is an indirect measure of the number of days potentially available for sparrow courtship and nesting (Van Lent et al. 1999). Pimm et al. (2002) estimate the nest cycle, including the number of days required for all the nesting stages (nesting, egg laying, incubation, and fledging), of CSSS to range from 34 to 44 days.

The NP-205 trigger stage of 6.01 ft NGVD was established in order to provide a minimum of 40 percent dry habitat during the sparrow breeding season. As previously stated, the Sparrow Viewer model indicates that that assumption is not valid, and that a figure closer to 25 percent dry habitat is actually occurring at that stage elevation. The achievement of the current 60 consecutive dry day criterion over 40 percent of CSSS-A habitat, which was intended under ERTP, has only been met in 8 out of 26 years (31 percent) of record. This level of breeding habitat is a direct effect of the operations, and is expected to continue to affect the CSSS with the continuation of the proposed action, ERTP-2016. The insufficient durations and amount of breeding habitat that have been provided throughout the period of record have not allowed the subpopulation to recover from the precariously low level which began in 1993, and if continued, can be expected to further diminish the sparrow's numbers, reproduction, or distribution so that the likelihood of survival and recovery in the wild is appreciably reduced.

Various researchers have recommended performance criteria based on the average annual number of consecutive days when water levels are below ground during the sparrow breeding season. For evaluation of subpopulations B through F, modeling of sparrow reproductive potential (Pimm and Bass 2001, Walters et al. 1999) supported the following general recommendations for evaluation of nesting condition availability:

- at least 80 consecutive days for 7 out of 10 years is favorable for population growth; and
- at least 80 consecutive days for 8 out of 10 years is considered very favorable.

Previous research has indicated that a minimum of two successful nesting periods (at least 80 days), during the majority of years was considered essential to maintain a stable and viable CSSS population. A target for subpopulation A of at least 80 consecutive nesting days in all years until sparrow numbers have increased to at least 1,000 individuals has also been suggested by researchers (Walters et al. 1999; Pimm et al. 2002).

In light of the current status and past performance of CSSS reproduction, the Service has determined that previously provided nesting conditions have not been sufficient. In order to keep CSSS-A extant and to begin recovery of the species as a whole, nesting conditions should include at least 90 consecutive dry nesting days (equivalent to at least two, and possibly three broods) over 24,000 acres of the CSSS-A in every year until there are enough birds to sustain yearly population growth.

2.5.1.1.2. Habitat Criteria

The average annual discontinuous hydroperiod required to maintain the wet prairie habitat where the CSSS currently resides is an important measure used to determine the effects of water management scenarios on the sparrow. Studies by Sah et al. (2008), confirm reports by Pimm et al. (2002), that sparrow habitat can remain suitable after experiencing hydroperiods up to 210 days, however, extended periods with annual hydroperiods of more than 210 days will shift the habitat from short hydroperiod marl prairie to wetter marsh habitat types unsuitable for sparrows. After review of the pertinent research and for the purposes of this BO, the target discontinuous hydroperiod has been designated to be 90-210 days.

Consistent with past evaluations, maintaining and restoring sparrow CSSS-A is essential to maintaining the overall sparrow population. CSSS-A has the potential to contribute to improved population resiliency more than any other subpopulation because it is the most isolated and geographically separated from the other sparrow subpopulations, thereby providing the greatest protection from risks associated with local catastrophic events, and because of the amount of potential habitat available it has the potential to support large numbers of sparrows. The extirpation of CSSS-A would represent a significant reduction in the distribution of the CSSS, and given its location and current condition would be a challenging area in which to reestablish a self-sustaining subpopulation if it were lost. Walters et al. 2000, stated “Recolonization of Population A is most problematic because of its isolation from the other populations by distance and barriers, especially Shark River Slough." "We conclude that under the current water management strategy, near-term extinction of Populations A and D are real possibilities." ERTP operations appear to have been insufficient to sustain this subpopulation at a viable level and the continuation of ERTP, is not expected to improve the status of this subpopulation.

Since 2009, the Service has been working closely with the Corps within the bounds of ERTP water management operations to provide improved hydroperiods within the marl prairies through coordination and periodic scientist calls. ENP (2015) stated that "hydrologic processes, such as the timing, depth and distribution of water, are the primary drivers of CSSS habitat suitability and a primary resource that can be managed in Everglades restoration." It has become evident that the situation has gone beyond making small changes in operations within regulations and rainfall plans, thus requiring additional action to protect the CSSS.

The proposed continuation of ERTP operations is not expected to significantly change the hydrologic pattern provided by previous operational plans in the other subpopulations of the sparrow. Previous ISOP and IOP operations of the S-332 Detention Areas may have somewhat improved hydrologic conditions within portions of eastern sparrow subpopulations C and F (ENP 2005). These detention areas have reduced the over-drying of sparrow habitat in these areas by reducing seepage out of ENP. This has likely reduced the risk of damaging wildfires, although several fires have occurred on the eastern side of NESRS during abnormally low rainfall years. The operation of these features has also resulted in more natural responses to rainfall events, which carries a degree of risk to sparrow nesting success because substantial rainfall during the nesting season is more likely to increase surface water levels within the eastern marl prairies.

The operation of the S-332 Detention Areas has also had indirect effects on sparrow habitat. Based on the results of IOP and ERTP to date, improved hydroperiods in the near future within CSSS-F are expected to support the recovery of marl prairie vegetation to conditions more favorable for sparrows, and increased hydroperiods are expected to help reduce the spread of encroaching woody vegetation within areas that were previously overdrained. However, seepage from the detention areas when canal levels are high, though low in volume, is expected to contribute to unfavorable vegetation in localized areas as a result of increased hydrology and nutrient levels. Future monitoring of these results would help to determine whether this will be a significant impact.

Impacts from ERTP on subpopulations B and E are expected to remain relatively small, but current modelling indicates the possibility of altered hydrology in both areas. It is difficult to discern the effects of IOP and ERTP on hydrologic conditions within sparrow subpopulation D due to the complicating influence of the C-111 Spreader Canal Project, which has been operational since 2012. Some effects are expected to occur in this area with the continued implementation of these projects, and will be quantified as part of required monitoring and analysis detailed in the C-111 Spreader Canal Project BO.

2.5.2. Indirect Effects

Indirect effects are those that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. The duration of this proposed action is expected to last until implementation of the Combined Operational Plan (COP) currently scheduled for early 2020. The main indirect impact evaluated by the Service includes the potential increased nutrient loading into ENP by a redistribution of flows through the S-333 and S-12 structures. Increased phosphorus loading has occurred within the Everglades and ENP. A water quality "exceedance" event occurred in NESRS in ENP from June 21 to July 31, 2014. The range of total phosphorus concentrations were 22 to 41 ppb from S-333 discharges with an average total suspended solids concentration of 10 ppm. Findings indicate this "exceedance" was due to a dynamic relationship between stage and total phosphorus concentrations observed at the S-333 structure monitoring stations, where phosphorus alternately settles when stages at the headwaters of S-333 fall below 8.5 ft NGVD and is resuspended as flow volume and velocity increase. Periodic interagency coordination meetings occur during which water quality and other factors are considered when planning water management actions. Most importantly, long-term water quality conditions and trends in the Everglades Protection Area and the long-term flow-weighted mean total phosphorus concentration for inflow structures to ENP continue on an improving downward trend (Martin, 2014).

The potential indirect effects of the proposed action on CSSS critical habitat was explored during the 2010 ERTP Biological Opinion through initial water quality analyses. Two suites of technical analyses on the potential water quality implications of ERTP were presented on October 19, 2010, to the Technical Oversight Committee, an interagency body composed of technical representatives of the primary settling parties of the 1992 Federal Consent Decree (Case No. 88-1886-CIV-MORENO). The Corps' draft water quality analysis (Shafer, 2010) involved several analytical approaches to better understand potential water quality impacts.

General conclusions from Shafer (2010) were that there may be a slight increase in phosphorus concentrations entering Shark River Slough, and that there may be up to a 7 percent increase in nutrient loading through the S-12 structures; however, recent ongoing monitoring shows a downward trend in phosphorus concentrations.

2.5.3. Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The Service has addressed all interrelated and interdependent actions in the analysis of effects above. Therefore, there are no interdependent or interrelated actions associated with the proposed action that have not already been analyzed under the effects of the action, that are expected to affect CSSS.

2.6. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological 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 Act.

Most of the lands in the Action Area for the CSSS are federally owned and managed. Therefore, the majority of impacts to CSSS and their habitat are anticipated to be related to future Federal actions that will require a separate consultation under the Act.

2.7. CONCLUSION

Research involving CSSS biology, population levels, demographics and habitat conditions have been conducted since the species was first described (Howell 1919) and more extensive research has been conducted since the first systematic population surveys in 1981. Beginning in 1993, the rapid decline in the CSSS population began to be documented, causes investigated, and its perilous status recognized.

Previous releases of water into habitat occupied by subpopulation A and the current inability to effectively manage water levels south of the S-12 structures have posed a significant risk to that subpopulation’s continued existence. Additionally, frequent lack of sparrows within subpopulations D and F along with the increase in discontinuous hydroperiods experienced within subpopulation D since the construction of the C-111 Spreader Canal Project has resulted in an increased urgency to achieve substantial benefits for the species in order to avoid the possible near-term extinction of these subpopulations. The risk of extinction of the CSSS is substantially increased by the reduction of viable subpopulations from three to two and the decrease in distribution across the landscape.

Rainfall events are expected to continue to affect the hydrologic conditions within subpopulation A during the nesting season. ERTP protections included in the 2010 BO, such as S-12A and

S-12B closures, Shark Valley Tram Road culvert plugs, and periodic scientist calls, were considered at the time to be sufficient to minimize the detrimental effects of these rainfall events on sparrow reproduction over the period of ERTP operations. These protections would be continued during the proposed continuation of ERTP implementation, but based on information discussed previously, these protections are now not considered sufficient to maintain CSSS-A at a viable population level.

Cape Sable seaside sparrows have a short life history (low annual survival and high fecundity), therefore they can be affected very quickly by anthropogenic changes that adversely affect sparrow breeding habitat. Given its short lifespan (2 to 3 years), the CSSS can experience rapid population declines over a short period of time if conditions severely limit or do not permit annual reproduction over several consecutive breeding seasons (Virzi et al. 2011).

The Corps intends to incrementally update the Water Control Plan as features come online with a comprehensive revision due in 2019-2020 when COP, or other such plan, is implemented. Many of these components were highlighted in the previous biological opinions prepared for the sparrow over the last 20 years. The failure of the current ERTP, and past IOP and ISOP, to achieve substantial increases in desired dry days during the nesting season, improved discontinuous hydroperiod throughout the rest of the year, improved habitat conditions within the CSSS subpopulations, and reverse the decline in population numbers, along with other concerns such as the increasing male biased sex ratios, make the delay of progress unacceptable.

Walters et al. 2000, in the AOU Conservation Committee Review of the Biology, Status and Management of Cape Sable Seaside Sparrows: Final Report emphasized the following conclusions at that time relating to the status and vulnerability of CSSS subpopulations, especially CSSS-A;

"Continued releases of water into habitat occupied by Population A pose a significant risk to that population's continued existence. We conclude that under the current water management strategy, near-term extinction of Populations A and D are real possibilities. We further believe that retaining water in WCA 3A rather than releasing it west of Shark River Slough and into Taylor Slough in wet years will substantially reduce the risk of extinction of Populations A and D."

"The best available means to reduce the risk of extinction of the Cape Sable seaside sparrow is to retain and recover Population A. Population E should be monitored carefully while interim water management remains in place, because the persistence of this population also is important to the future of the sparrow."

And also relating to the importance of CSSS-A to the viability of the sparrow population as a whole they concluded;

"The risk of extinction of the total population obviously is increased by the reduction of the number of large populations from three to two." (*i.e.*, the loss of A, and persistence of B and E).

Ten years later, Slater (2009), as part of the preparation of an Emergency Management Action Plan for the Endangered Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*), observed;

"The sparrow population has shown no signs of recovery and we see little of the habitat restoration deemed necessary for their recovery. Therefore we must emphasize that, without amending the conditions that led to the bird's initial decline, any implementation of emergency actions are prone to failure."

"Now 90-97% of the remaining sparrows are concentrated within two subpopulations (B and E). This restricted distribution makes the sparrow particularly vulnerable to stochastic events." This statistic has improved slightly to 87 percent of the remaining sparrows in 2015 being located within subpopulations B and E.

This same report concerning the status of the smaller CSSS-D further observed;

"Due to the restricted range of the CSSS and the limited number (and condition) of remaining subpopulations, the potential loss of any sparrow subpopulation increases the probability of extinction for the entire species. Thus, any potential anthropogenic changes to hydrologic conditions in subpopulation D that may adversely affect sparrow breeding habitat must be monitored closely."

"The biggest issue of concern is the severely male-biased sex ratio that has persisted in the subpopulation in recent years, which has led to very low overall annual productivity due to the lack of enough females. Whether this is the result of low female survival or dispersal limitations is presently unknown. Regardless, a high proportion of unmated males raises concern that the subpopulation D may be in trouble and at high risk of local extinction."

A more recent report (Virzi and Davis 2013) based on intensive monitoring conducted in CSSS-A concluded;

"Unfortunately, the low return rate of male sparrows observed in subpopulation A in 2013 could be an indication that our hypothesis was correct, and it is possible that we may already be very close to the critical mass necessary for this subpopulation to persist."

"It is possible that subpopulation A could be dropping below a critical threshold necessary to attract settling males. Regardless of the cause, the low return rate for males observed in subpopulation A in 2013 is alarming and should be monitored closely."

"A classic example of the consequence of a severely male-biased adult sex ratio in a small avian population occurred in the now extinct Dusky seaside sparrow (A. m. nigrescens) when surveys from 1977-1979 located 28, 24, and 13 males respectively, while the last female was seen in 1975 (Delaney et al. 1981). The current skewed sex ratio in subpopulation A (and other small sparrow subpopulations) is reminiscent of the Dusky extinction. Thus, we are concerned that if

more female sparrows do not recruit into subpopulation A we will see a continued and perhaps rapid decline in sparrow numbers in this already very small sparrow subpopulation."

Recently, Pimm et al. 2014, concluded;

"We predict that the Cape Sable seaside sparrow subpopulation west of Shark River Slough will decline to extinction if the pattern of managed flows over the S-12 structures for the last 20 years is repeated."

In reference to CSSS-A and sparrows occurring in the southern portion (all sites south of 3 km south of NP-205) of the subpopulation Pimm et al. 2014 observed;

"What is most striking is the declines in numbers to the south. Apart from sporadic sightings, the birds have been entirely lost from about two hundred square kilometers broadly centered on the water monitoring station P34. This was where 75% of the birds once lived."

"Nonetheless, we offer the following tentative conclusion: the Cape Sable seaside-sparrow will only survive if it has at least three healthy subpopulations. To implement this requirement, the breeding areas west of Shark River Slough must not be flooded in the breeding season, and water levels should be raised in the northeast of Shark River Slough to reduce the incidence of fires."

Pimm et al. 2014 also included the following qualifier for further concerns;

"Our models omit some obvious features. We have not included the effects of prolonged inundation or of frequent fires on the vegetation. These processes alter the vegetation in ways that preclude the birds' use of areas for several years (Curnutt et al. 1998, Nott et al. 1998). Incorporating these impacts would likely lead to even greater concerns about the sparrow's future."

Discontinuous hydroperiod has been highlighted in this BO as a major concern in terms of its effect on vegetation and the provision of optimal sparrow habitat. Several researchers have expressed concern relating to this. Walters et al. 2000 noted;

"The key element for the sparrows is that flow patterns produce hydroperiods similar to those that characterized the marl prairies prior to management of water by humans."

In addition several researchers have noted that shorter discontinuous hydroperiod marl prairie species can be rapidly replaced when wetter conditions prevail, but the opposite effect resulting in recovery may be much slower. Habitat quality is key to the vitality of the CSSS population, and this observation gives additional reason for concern. Pimm et al. 2002 observed;

"Three years of almost continual flood caused significant damage to sparrow habitat that is only now, six years later, regaining its former extent."

And Sah et al. 2013 recently documented;

"When muhly grass-dominated prairie is exposed to increased hydroperiod, several species characteristic of short hydroperiod conditions are less likely to thrive, and the communities show relatively low resilience to increasing wetness. In contrast, once established, species characteristic of long hydroperiods, such as sawgrass and R. tracyi may take longer to be replaced by prairie species. These species have wide range of hydrologic tolerances and often flourish in organic soils resulted from long hydroperiod as was present in the slough (Taylor) during the S332i (1993-1999) period. But, prairie species, such as muhly grass, usually get established on only marl soils, and are often favored by fire (Olmstead et al. 1980). For instance, the combination of prolonged dry conditions and consumption by fires of shallow organic soil in sawgrass-dominated landscape has been cited as the major cause of the expansion of muhly grass-dominated prairie vegetation in marl prairies (Werner 1975; Olmsted et al. 1980; McVoy et al. 2011)."

Finally, researchers have concluded that a consecutive day dry period sufficient to accommodate at least two broods is crucial to achieve a stable population. Walters et al. 2000 concluded;

"First, lack of nesting has a dramatic effect on population behavior, but the opportunity to attempt a second brood may have a substantial effect as well."

"It is conceivable that the opportunity to attempt a second brood could make the difference between a declining and an increasing population. Second, survival rates required to achieve a stable population in the absence of multiple brooding may be unrealistically high."

"Specifically, we recommend that water be managed to enable high productivity until Population A has recovered to at least 1,000 breeding birds. A dry period of 50 to 60 days beginning 15 March is the minimum required to ensure reasonable productivity, and a period of 80 days is preferable."

Pimm et al. 2002, concurred, stating;

"Only when the great majority of the nesting pairs in a population can all rear two or more broods can the population grow significantly from one year to the next. The observed failure of the western population, A, matches what we expect from this demographic analysis."

and in Pimm et al 2014, pointing out the following target had been implemented as part of Everglades restoration in all years;

Based on our results, Corps 2002 C-111 GRR Supplement, Section 5.1: Planning goals and objectives, stated as a target: "a minimum of 50 to 60 consecutive nesting days, preferable 80 consecutive days, in all years until the sparrow numbers have increased into at least 1,000 individuals."

In summary:

1) Extirpation of CSSS-A is a very real possibility, and the retention and recovery of a viable third subpopulation is the best available means to reduce the risk of extinction of the overall CSSS population.
2) Population estimates through the period following the significant decline in sparrow numbers have shown few signs of recovery of the population or its habitat and the species remains extremely vulnerable to changes.
3) Some smaller subpopulations are showing signs similar to those that preceded the extinction of the dusky seaside sparrow.
4) Habitat damage as a result of altered hydrologic conditions can occur rapidly, but recovery to healthy marl prairie habitat is slow.
5) Continued operation of water control structures resulting in altered flow regimes in sparrow habitat will continue the sparrow's decline toward extinction.
6) Provision of optimal breeding conditions based on the number of consecutive dry days during the sparrow breeding season that facilitates two or more broods, is essential for population vitality and growth.

After reviewing the current status of the CSSS, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Corps' proposed action is likely to jeopardize the continued existence of the CSSS.

The Service reached this conclusion based on the previously discussed studies and reports and the following additional information:

- The Corps reinitiated consultation on ERTP in November, 2014, due to exceeding a measure of exempted incidental take; specifically "If the annual CSSS population estimate falls below 2,915 sparrows [Mean population estimate 2001-2009 = 3,145 ± 230]), reinitiation of consultation must occur." This population trigger level has been exceeded in three years since 2010 (2011, 2,896 birds; 2014, 2,720 birds; 2016, preliminary population estimates 2,416 birds).
- ERTP had a minimum target stage of 60 consecutive dry days over 40 percent of CSSS-A during the breeding season. The 60 consecutive dry day target was established to achieve one successful nesting period per year. However, according to data provided by the Sparrow Viewer model, the trigger stage of 6.01 ft at the NP-205 gauge only provides 24 percent of acreage within the boundary of CSSS-A in optimal dry breeding condition rather than the 40 percent threshold that ERTP assumed was being provided to maintain sparrows in CSSS-A.
- In CSSS-A, the target of 60 consecutive dry days over 40 percent of the area has only been met in 31 percent of the years of record while the NP-205 gauge water level criteria of 6.01 ft (24 percent dry level) was achieved in just over half (58 percent) of years. The remaining 42 percent of the years were not able to achieve 60 consecutive dry days over at least 25 percent of the available habitat within subpopulation A. This is not adequate to maintain the subpopulation.

- It has been determined that a minimum of two successful nesting periods (at least 90 days with no surface water), over 40 percent of the area, in the majority of years is needed to maintain a stable and viable CSSS population. This has only been met in CSSS-A in 3 out of 26 years (11 percent) of record.
- Habitat changes in subpopulation A, as well as other subpopulations, continue to impact the survival and recovery of the sparrow. Marl prairie requires an annual discontinuous hydroperiod of between 90 and 210 days. At least 40 percent of available habitat must achieve the target 90-210 day hydroperiod range in order to provide sufficient suitable habitat for sustainable breeding conditions that facilitate CSSS population viability. However, subpopulation A averaged only 9 percent of its acreage within the optimal range during the period of 1992 to 2014. While the larger and more stable subpopulations B and E, as well as the smaller D and F, on average had 33 to 39 percent of their total available habitat in the target hydroperiod range.
- As a result of declining habitat conditions, altered hydrology, and other effects, the three year running average of the annual rate of increase (r), a recovery metric for the CSSS, has declined. Within the last 10 years (2005-2014), the annual rate of increase was greater than 0 in 2 years, and less than 0 in 8 years. In the previous ten years (from 1994 to 2004), the three year running average of r was greater than 0 in 6 years, and less than 0 in 4 years.
- A biased sex ratio in favor of males is frequently observed in species as a precursor to extinction (Donald 2007). Intensive ground research has revealed this is the case in most of the small CSSS subpopulations. Two other subspecies of seaside sparrows have gone extinct in Florida (Smyrna and dusky) and the closely related Florida grasshopper sparrow has declined close to extinction. These three sparrow species are all closely related to CSSS (all four taxa are in the genus *Ammodramus*), and the patterns of decline and extinction for these species closely match what is being observed with CSSS. The consistent pattern is a sequence of habitat fragmentation and degradation followed with a biased sex ratio and a decline in subpopulation size to the point where subpopulations eventually drop below a threshold size and then expire. When all subpopulations expire extinction occurs. This pattern appears underway with CSSS.
- Revised population estimates which take into account the current biased sex ratios, indicate that the CSSS population may be 11 to 12 percent lower than the current estimates and that some individual subpopulations may be as much as 20 to 50 percent lower than the current estimates.
- Jeopardy opinions for the CSSS were issued in 1995 and 1999. These jeopardy opinions contained RPAs which outlined a set of projects that needed to be done, including the Modified Water Deliveries to Everglades National Park, in order to maintain short hydroperiods in the marl prairies and move water to the east away from CSSS-A. Many of these components have not yet been completed.
- Annual peak levels of the estimated population in CSSS-B and the total CSSS population have gradually declined since 1981. Since 1992, population estimates for CSSS-A, CSSS-C, and CSSS-D have consistently trended lower and remain at extremely low levels. CSSS-A comprises 41 percent of all current delineated CSSS habitat areas and has the largest potential for improvement. The average discontinuous hydroperiod

(optimal target 90-210 days) in CSSS-A has averaged 289 days from 1992 through 2014, and 241 days for the last ten years. This is too wet to maintain CSSS habitat.

- The southern and western portions of CSSS-A (roughly half), have consistently exhibited wet conditions throughout the 1990 to 2015 period of record to the point that it appears to no longer be viable habitat, and unless major changes are made to factors affecting this, may not be able to be restored.
- Sea level rise represents significant short and long term threats to the environmental baseline of CSSS habitat population wide. Subpopulations A, B, and D are particularly vulnerable in the near term and may already be experiencing detrimental habitat effects related to sea level rise. This represents an increased level of risk in addition to the proposed action.
- Two recent introductions, the Burmese python, and the black and white tegu are of major concern. Both species represent a potential new threat as predators, are now an established part of the environmental baseline, and represent an increased level of risk not previously considered for the CSSS.
- The Corps' proposed action is the continuation of operations as defined by ERTP with no recommended modifications to address the impacts to CSSS. The Corps' continued action will appreciably reduce the likelihood of survival and recovery of this species.

3. CAPE SABLE SEASIDE SPARROW CRITICAL HABITAT

3.1. STATUS OF THE CRITICAL HABITAT

This section summarizes the effects of all past human and natural activities or events that have led to the current status of designated critical habitat for the Cape Sable seaside sparrow and are relevant to formulating the biological opinion about the proposed action.

3.1.1. Critical Habitat Description and Status

Critical habitat for the CSSS was initially designated on August 11, 1977 (42 *FR* 42840). The critical habitat designation was revised on November 6, 2007 (50 FR 62736) and the revised habitat included the following primary constituent elements (PCE), which are those physical and biological features essential for the conservation of the species:

1) Calcitic marl soils characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades. These soils support the unique vegetation community and probably many of the food items upon which sparrows depend. They also result from specific hydrologic conditions that are characteristic of the marl prairies. These soils are an integral component of sparrow habitat.

2) Herbaceous vegetation that includes greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species (when measured across an area of greater than 100 ft^2): muhly grass, Florida little bluestem, black-topped sedge, and cordgrass. These plant species are largely characteristic of areas where sparrows occur. They act as cover and substrate for foraging, nesting, and normal behavior for

sparrows during a variety of environmental conditions. The species identified in the PCE consistently occur in areas occupied by sparrows (Sah et al. 2007), however, many other herbaceous plant species and low-growing forbs also occur within sparrow habitat (Ross et al. 2006), and some of these may have important roles in the life history of the sparrow.

3) Contiguous open habitat. Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. This PCE provides the space for population and individual growth, and also provides the open, contiguous habitat that sparrows prefer.

4) Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches longer than 30 days during the period from March 15 to June 30 more than 2 out of every 10 years.

The critical habitat designation, as amended in 2007 (50 FR 62736), designated five units as critical habitat for the CSSS. These critical habitat units represent the areas determined to be occupied at the time of listing that contain one or more of the characteristics that are essential for the conservation of the species (PCEs) and that may require special management (Figure 4). The units designated as CSSS critical habitat in the Action Area are: (Unit 1) marl prairie habitats that support sparrow subpopulation B and lie exclusively within ENP in the vicinity of the Main Park Road (State Road 9336), between SRS and Taylor Slough; (Unit 2) marl prairie habitat that supports sparrow subpopulation C within ENP along its eastern boundary in the vicinity of Taylor Slough; (Unit 3) marl prairie habitats that support sparrow subpopulation D in the state-owned and managed Southern Glades Wildlife and Environmental Area to the east of Taylor Slough and ENP; (Unit 4) marl prairie habitat that supports subpopulation E within ENP located on the eastern edge of SRS; and (Unit 5) marl prairie habitat that supports subpopulation F within ENP located just west of the S-332B pump station and detention area and L-31N canal.

Currently, critical habitat includes areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Miami-Dade, and Monroe Counties. Much of this area is within the boundaries of ENP. The designated area encompasses about 84,865 acres and includes subpopulations B through F (Figure 3). Subpopulation A is not included as part of the critical habitat. It was excluded per the Secretary's discretion as described in 50 CFR 62736.

The following descriptions summarize baseline conditions in critical habitat Units 1, 2, 3, 4, and 5.

<u>Unit 1 (Subpopulation B)</u>

Unit 1 consists of 39,029 acres of marl prairie and lies exclusively within ENP. The unit is bounded on the south by the long hydroperiod Eleocharis-dominated wet prairie and mangrove zone just inland of Florida Bay, on the west by the sawgrass marshes and deepwater slough communities of SRS, on the north by the pine rockland vegetation communities that occur within ENP on Long Pine Key, and on the east by the sawgrass marshes and deepwater slough vegetation communities of Taylor Slough. There is a continuous topographical gradient across the site, from the slightly higher elevated pine rocklands north of the unit down to the lower-lying mangroves in the south. The area is bisected by the Main Park Road, which serves as the primary public access route from Homestead to Flamingo and Florida Bay. It is also bisected by the Old Ingraham Highway, which is the original historical roadway that provides alternate access to Florida Bay. Much of the western portion of this roadway was removed and restored to grade, but the eastern portions of the road, with its associated borrow canal and woody vegetation encroachment, interrupt the continuity of the prairies within the eastern portion of this unit. Besides the road, borrow canal, and woody vegetation, which are not critical habitat, the area consists of one large, contiguous expanse of marl prairie that contains all of the PCEs for the sparrow.

When sparrows were first recorded in the area during the 1974 to 1975 surveys, they were abundant and widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. Consequently, the Service considered the unit to be occupied at the time of listing. The area is the largest contiguous patch of marl prairie east of SRS. It is currently occupied, and has consistently supported the largest sparrow subpopulation ranging from an estimated 1,792 to 3,184 birds since 1992 (Pimm and Bass 2002, 2005; Pimm et al. 2002, 2007) (Table 1).

The natural characteristics of this area make it relatively immune to risk of flooding or frequent fires (Walters et al. 2000). Its location south of the higher-elevation pine rocklands provides it a degree of protection from high water levels compared to other units. Within the southern portion of the greater Everglades watershed, surface water generally flows from north to south, with most water moving through SRS, and to a lesser extent through Taylor Slough. The pinelands block the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of Unit 1 occur on relatively high elevations and remain relatively dry. Consequently, this area is not easily flooded as a result of managed water releases or upstream events, and the high-water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics.

Similarly, the area is not particularly vulnerable to fires. It is not overdrained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and managed prescribed fire. The public road that traverses the area could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides human access greater than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2 (Subpopulation C)

Unit 2 consists of 8,304 acres of marl prairie habitat that lies exclusively within ENP in the vicinity of Taylor Slough, along the eastern edge of ENP. The unit consists of the prairies that flank both sides of the relatively narrow Taylor Slough. The area is bordered by the pine rocklands of Long Pine Key on the west and by isolated pine rocklands and the L-31W canal that runs along the ENP boundary to the east. It is bordered by an area of constriction in Taylor Slough that is closely flanked on both sides by forested habitats at the southern end and by the Rocky Glades, a region of thin marl soils and exposed limestone and sparse vegetation to the north. The area is bisected by the Main Park Road in the southern portion of the unit, but the remainder of the unit consists of contiguous marl prairies.

Sparrows were not discovered in the area until 1972 (Ogden 1972). At the time of discovery, sparrows were found to be widely distributed and abundant in this area (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that sparrows have occupied this locality since at least the time of initial listing on March 11, 1967. Following its discovery, the site was the location of some of the first intensive study of the sparrow's biology and its relationship to its habitat (Werner 1975).

During the mid-1970s, sparrows were abundant at this site (Werner 1975), and surveys in 1981 estimated 432 sparrows in this area (Pimm et al. 2002). Since 1981, the sparrow subpopulation at this site has declined and estimates have ranged from 0 to 1,176 sparrows between 1992 and the present (Pimm et al. 2002; Pimm and Bass 2005) (Table 1). During intensive nest surveys in 2008, Virzi et al. (2009) documented four females and five males, nine nest attempts and reported nest survival as 22.8 percent and in 2009, 9 males and 5 females were documented. No additional intensive nest surveys have been conducted in this subpopulation to date. When sparrows were abundant in this area, the habitat was in a relatively dry condition, with average annual hydroperiods between 90 and 180 days (ENP 2005).

Beginning in 1980, a pump station (S-332), installed along the eastern boundary of ENP at the approximate location of the historic slough, was operated to increase hydroperiods in the area. This resulted in extended hydroperiods within the portions of the area downstream from the pump station and vegetation changed from suitable marl prairie to unsuitable sawgrass marsh due to altered hydrology as a result of the S-332 pump station operations (ENP 2005), and sparrows ceased to occur in this area. At the same time, the northern portions of Unit 2, north of pump station S-332, continued to be overdrained as a result of pump station and adjacent canal stage operations which effectively lowered the water table in the surrounding agricultural lands immediately bordering ENP (Johnson et al. 1988; ENP 2005).

In these over drained areas, frequent fires impacted the habitat and resulted in reduced sparrow numbers (Pimm et al. 2002). A large fire occurred in March 2007 when the Frog Pond fire swept through this area. Sah et al. 2010 and Virzi et al. 2009, observed that the habitat then was beginning to recover.

Unit 2 provides a contiguous expanse of habitat that is largely separated from other nearby subpopulations in an area that is uniquely influenced by hydrologic characteristics. The Taylor Slough basin is a relatively small system, and much of the headwaters of the Slough are cut off by canals, agricultural land, and development to the east of ENP. Portions of this unit near the slough have deep soil (15.7 inches) (Taylor 1983) and support resilient vegetation that responds rapidly following fire (Taylor 1983; Werner and Woolfenden 1983).

Sparrows were reported to reoccupy burned sites in this region within 1 to 2 years following fire (Werner and Woolfenden 1983). The unit contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrows use. However, the area along the eastern boundary of ENP remains heavily influenced by water management operations (ENP 2005). Portions of the area are also over drained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of SRS in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in aiding dispersal among the eastern subpopulations, acting as a ''hub'' that facilitates dispersal in the region and recolonization of local areas that are detrimentally impacted and locally extirpated.

Unit 3 (Subpopulation D)

Unit 3 consists of 10,806 acres of marl prairie vegetation in an area that lies on the eastern side of the lower portion of Taylor Slough. The majority of this area, 92 percent or 9,973 acres, is within the Southern Glades Wildlife and Environmental Area, which is jointly managed by the District and Florida Fish and Wildlife Conservation Commission (FWC). The remaining 8 percent (883 acres) occurs within the boundary of ENP. The area is bordered on the south by the long hydroperiod eleocharis vegetation and mangroves that flank Florida Bay, on the west by the sawgrass marshes and deepwater vegetation of Taylor Slough, on the east by long-hydroperiod eleocharis vegetation and over drained areas with shrub encroachment in the vicinity of U.S. Highway 1, and on the north by agricultural lands and development in the vicinity of Homestead and Florida City.

When sparrows were discovered in this area, they were widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that the sparrows have occupied this locality since at least the time of listing. This is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is consequently unlikely to be affected by the same factors (*e.g.*, large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between SRS and Taylor Slough. This area is separated from other sparrow subpopulations by Taylor Slough and the agricultural and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape would tend to prevent potential fires from spreading from the area of sparrow subpopulations B, C, E, and F into the subpopulation D area.

Similarly, hydrologic conditions in this region are different than those that affect the other subpopulations because water levels are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban and agricultural areas to the north.

The 1981 comprehensive population survey estimated 400 sparrows within this region (Pimm et al. 2002). This was higher than any number of sparrows recorded in the area in recent years, and estimates have ranged from 0 to 224 sparrows since 1992 (Pimm et al. 2002; Pimm and Bass 2005) (Table 1).

The area contains all PCEs, but the majority of the area is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006). There is a small portion of the subpopulation critical habitat area that is somewhat higher (0.5 to 0.75 ft.) in elevation, and depending on current ambient water level conditions offers a variable core habitat area utilized by sparrows. The larger scale habitat in this area is divided by several canals that are part of the C–111 basin. This canal system results in altered hydrologic conditions in the region (ENP 2005) and causes extended hydroperiods during wet periods (Pimm et al. 2002). The C-111 Spreader Canal Phase 1 Project, adjoining this critical habitat area, was constructed and became operational in 2012. Effects of the project were analyzed and documented in the Service's Biological Opinion (Service 2009). Operational constraints that limit the amount and timing of water that can be pumped through project features that may affect the sparrow, and monitoring are ongoing in the area to determine if planned conditions for the project are being realized or if adaptive management may be required.

<u>Unit 4 (Subpopulation E)</u>

Unit 4, subpopulation E, consists of 22,278 acres of marl prairie habitat in an area that lies along the eastern margin of SRS. This unit occurs entirely within ENP. The area is bordered to the south by the pine rocklands of Long Pine Key and by an area dominated by dwarf cypress trees. The sawgrass marshes and deepwater slough vegetation communities of SRS comprise the western and northern boundary of the area, and the Rocky Glades comprise the eastern boundary.

When sparrows were discovered in this area, they were relatively widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 40 years ago. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840).

This area supports one of the large, relatively stable sparrow subpopulations. It is centrally located among the areas supporting other subpopulations, and its location probably plays an important role in aiding dispersal among subpopulations, particularly movements from the eastern subpopulations (Units 1 – 5) to the only subpopulation west of SRS, subpopulation A. Since 1992, this area has consistently supported the second largest sparrow subpopulation in most years, with estimates ranging from 112 to 1,040 individuals (Pimm et al. 2002; Pimm and Bass 2005) (Table 1).

The location of this subpopulation helps to protect it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of managed water releases is generally dampened by the time their influence reaches this area. However, the proximity of this area to SRS may make the habitats and the sparrows that they support vulnerable to hydrologic effects during wet periods. The western portions of the area may become too deeply inundated to provide good habitat for sparrows under some deep water conditions such as occurred during the 2016 nesting season. Large-scale hydrologic modifications, such as those proposed under the CERP, have the potential to influence habitat conditions in this area, and may require special management attention. Large-scale fires may detrimentally affect this area since there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation. While the area is relatively distant from ENP boundaries and potential sources of human-caused ignition, fires that are started along the eastern ENP boundary may rapidly spread into the area. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

<u>Unit 5 (Subpopulation F)</u>

Unit 5, subpopulation F, consists of 4,883 acres of marl prairie that lies along the eastern boundary of ENP, and is the northernmost of the designated critical habitat units. Unit 5 is also the smallest of the five units. It is bounded on the north and west by ENP sawgrass marshes and deepwater slough vegetation communities associated with SRS, and on the east by agricultural and residential development along the eastern boundary of ENP. Its southern boundary is defined and characterized by the sparse vegetation, shallow soils, and exposed limestone depressions and solution holes of the Rocky Glades. When sparrows were discovered in this area, they were relatively widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of initial listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 *FR* 40685 and 42 *FR* 47840).

The first comprehensive CSSS population survey conducted in 1981 resulted in an estimated population of 112 sparrows in this area, and most subsequent surveys have resulted in estimates lower than this (0 to 112), including several years (1993, 1995, 1999, 2000, 2007, 2008, and 2009), when no sparrows have been found (Pimm et al. 2002; Pimm and Bass 2005) (Table 1). Since 2010 sparrows have been found in the area, indicating that sparrows are consistently, albeit at low numbers, using the area.

This area could serve to support or recolonize subpopulations C and E (Units 2 and 4). Loss of available habitat in this area would result in a reduction in the total spatial distribution of sparrows. Its position in the landscape results in a unique set of threats that differ from those in other subpopulations. Because of its proximity to urban and agricultural areas and its relative topographic location, this area has been consistently over drained in recent years and remains dry during the year for longer periods than other subpopulations (shortened hydroperiod). The relative dryness of the area may allow the site to remain suitable as habitat for sparrows under very wet conditions, when other subpopulations may become deeply inundated for long durations.

Due in large part to its relatively drier hydrologic condition and its proximity to developed areas, Unit 5 has been subjected to frequent human-caused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine, melaleuca, and Brazilian pepper, have become established in local areas often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by resource management agencies to address this issue, and control of woody vegetation will continue to be necessary.

3.1.2. Factors Affecting Critical Habitat

One of the Primary Constituent Elements (PCEs) used to designate critical habitat for the CSSS stipulated a hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years. This PCE provides the hydrologic conditions that are required to support and maintain the vegetation composition that sparrows require, as well as those conditions that allow for successful nesting. The period of measurement coincides with the sparrow breeding season, as well as the late portion of the dry season and the early wet season. Water depths greater than 7.9 inches (20 cm) during this period can result in elevated nest failure rates (Lockwood et al. 1997, Lockwood et al. 2001, Pimm et al. 2002). If these water depths occur for short periods during nesting season, sparrows may be able to re-nest within the same season. These depths, if they occur for sustained periods (>30 days) within sparrow nesting season more frequently than 2 out of 10 years, may reduce successful nesting to a level that could be insufficient to support a population. In addition, because this period of measurement coincides with the dry season and early wet season, and because water levels generally recede slowly, water depths greater than specified or that occur for periods longer than specified, will generally result in conditions that do not support the vegetation composition required by the sparrow. These hydrologic conditions are necessary to maintain suitable conditions for sparrows occupying these areas, support the species of vegetation that are essential to sparrows, and to prevent flooding sparrow nests.

<u>Unit 1</u>

The natural characteristics of Unit 1 (subpopulation B) make it relatively less susceptible to risk of human-induced flooding or frequent fires (Walters et al. 2000). Its location south of the high-elevation pine rocklands provides it a degree of protection from high water levels that do not occur within any other units. Within the southern portion of the greater Everglades watershed, water flows from north to south, with most water moving through SRS, and to a lesser extent through Taylor Slough. The pinelands interrupt the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of the area occur on relatively high elevations and remain comparatively dry. Consequently, this area is not as easily flooded as a result of managed water releases or upstream events, and the high-water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics. However, as demonstrated by various model scenarios, changes in water management actions do result in changes to habitat conditions within this unit.

Unit 1 is also not particularly vulnerable to fires. It is not over-drained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and intensively managed prescribed fire. The public road that traverses Unit 1 could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides greater human access than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2

Unit 2 (subpopulation C) contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrow use. However, the area along the eastern boundary of ENP remains heavily influenced by hydrologic management (ENP 2005). Portions of the area are also over drained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of SRS in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in supporting dispersal among the eastern subpopulations, acting as a ‘‘hub’’ that facilitates dispersal in the region and recolonization of local areas that are detrimentally impacted.

Construction of the S-332B North and West Detention Areas and the associated pumps and operations schedule has resulted in wetter conditions and improved habitat quality in some areas and the desired water stage during the sparrow nesting window in subpopulation C critical habitat.

Unit 3

Unit 3 (subpopulation D) is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is consequently unlikely to be affected by the same factors (*e.g.*, large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between SRS and Taylor Slough. This area is separated from other sparrow subpopulations by Taylor Slough, and the area immediately north of this subpopulation consists of agriculture and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape tend to prevent fires from spreading into Unit 3.

Similarly, hydrologic conditions in Unit 3 are different than those that affect the other subpopulations because water levels are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban/agricultural areas to the north. The 1981 comprehensive population survey estimated 400 sparrows within Unit 3 (Pimm et al. 2002). This was higher than any number of sparrows recorded in the area in recent years when estimates have ranged from 0 to 112 sparrows between 1992 and the present (Pimm et al. 2002; Pimm and Bass 2005; Virzi et al. 2009).

Unit 3 currently contains all of the PCEs, but the majority of this unit is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006). The habitat in Unit 3 is divided by several canals that are part of the C–111 basin. This canal system results in relatively altered hydrologic conditions in the region (ENP 2005) and causes extended hydroperiods during wet periods (Pimm et al. 2002).

CSSS Unit 3 critical habitat was affected when canal infrastructure for the SDCS was completed in the 1980s. The SDCS was originally constructed to meet agricultural water supply needs, flood control, and mitigate saltwater intrusion as part of the overarching C&SF Project. More recently the C-111 South Dade project (Corps 1994) was modified by adding a series of detention areas aimed at retaining water within ENP by reducing seepage out of ENP into the C-111. In addition, in the 1960s, Aerojet-General Corporation built a plant, other infrastructure, and the Aerojet Canal, which is now within the Unit 3 critical habitat boundary, to supply NASA with solid rocket fuel components. It was closed after NASA chose liquid fuel for the Saturn V program. When the Aerojet product was not selected for the Saturn project, the land and facilities were returned to the State, and are now managed by the SFWMD and FWC as a nature preserve.

<u>Unit 4</u>

The central location of Unit 4 (subpopulation E) helps to prevent it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of any managed water release is generally dampened by the time their influence reaches this area. However, the proximity of this area to SRS may make the habitat and the sparrows that it supports vulnerable to hydrologic effects during wet periods. The western portions of Unit 4 may become too deeply inundated to provide good habitat for sparrows under certain conditions. Large-scale hydrologic modifications, such as those proposed under the CERP, have the potential to influence habitat conditions in Unit 4, and may require special management attention (*e.g.*, attention to the timing and volumes of flows into NESRS). Large-scale fires may detrimentally affect Unit 4, and there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation. While this unit is relatively distant from ENP boundaries and potential sources of human-caused ignition, fires that are started along the eastern ENP boundary may rapidly spread into Unit 4. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

Unit 5

Because of its dryness and its proximity to developed areas, Unit 5 (subpopulation F) has been subjected to frequent human-caused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine, melaleuca, and Brazilian pepper, have become established in local areas (Werner 1975), often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by resource agencies to address this issue, and control of woody vegetation will continue to be required.

All Units

Observable habitat changes in the CSSS critical habitat appear to be impacting the survival and recovery of the sparrow. Marl prairie requires an annual discontinuous hydroperiod of between 90 and 210 days. PCE 2 outlined in the revised critical habitat designation for the Cape Sable seaside sparrow (50 FR 62736), specifies herbaceous vegetation that includes greater than 15 percent combined cover of live and standing vegetation comprised of one or more of Muhly grass, Florida little bluestem, black topped sedge, and cordgrass. These plant species are largely characteristic of areas where sparrows occur and act as cover for foraging, nesting, and normal behavior for sparrows during a variety of conditions. In areas where the annual discontinuous hydroperiod frequently approaches or exceeds the upper threshold of 210 days the habitat transitions to more wet tolerant species such as sawgrass and cattail. In those areas where the annual discontinuous hydroperiod frequently approaches or is less than the lower 90 day threshold, the habitat shifts toward woody vegetation and there is an increased risk of fire.

The average annual baseline discontinuous hydroperiod at R3110 (the trigger gauge for operations of the S-200 structure in CSSS-C), over the 1992 to 2015 period of record has been 216 days and during the last ten years has increased to 223 days, both above the optimal 90-210 day range. Inspection of data for the eastern subpopulations CSSS-C, CSSS-D, CSSS-E and CSSS-F (Tables 8, 10, 11, and 12), indicate that the period from 2009 to 2015 reflects much wetter conditions compared to the previous 1992 to 2008 period, in terms of average discontinuous hydroperiod days. Beginning in 2009 through present both R3110 (average 243 days) and the overall average for all gauges in the vicinity of CSSS-C (219 days) has consistently exceeded the target discontinuous hydroperiod. These observations appear to conflict with previous project model results which expected the habitat within CSSS-C to shift from overly dry conditions to more suitable habitat that would trend more towards the optimal 90-210 day discontinuous hydroperiod range during IOP and ERTP.

The average annual baseline discontinuous hydroperiod at EVER4 (the trigger gauge for operations of the S-199 structure in CSSS-D), over the 1990 to 2015 period of record has been 215 days and during the last ten years 227 days, both above the optimal 90-210 day range. Beginning in 2009 through present the EVER4 gauge average has been 253 days and has consistently exceeded the target discontinuous hydroperiod. New gauges (CSSS-D1, CSSS-D2, and CSSS-D3) were installed in CSSS-D as part of monitoring for the C-111 Spreader Canal Phase 1 Project in 2011. Two of these gauges (CSSS-D1 and CSSS-D2) are in, or in close proximity to a core habitat area for this subpopulation where sparrows have routinely nested or have been observed in recent years. The average annual discontinuous hydroperiod at these two gauges since 2011 has been 136 and 182 days respectively, well within the 90-210 day range, indicating that hydrologic conditions are appropriate for the maintenance of habitat for the sparrows to utilize in this core area. During this same period, the average discontinuous hydroperiod at EVER4 has been 248 days which is an increase of 33 days over the average for the period of record, demonstrates that the discontinuous hydroperiod at EVER4 has increased since the completion of the C-111 Spreader Canal Project. The third newly installed gauge, CSSS-D3, was installed at a location near habitat that is only used by sparrows for breeding during dry years. This gauge location appears to be heavily influenced by the headwater stage level at the S-18C structure on the C-111 canal. Since 2011, the average annual discontinuous hydroperiod at CSSS-D3 has been 310 days. Assuming the same effects to hydrology have occurred at the CSSS-D1 and CSSS-D2 gauge locations as at EVER4, even though the discontinuous hydroperiod at CSSS-D1 and CSSS-D2 are within the acceptable range, they were likely drier prior to the completion of C-111 Spreader Canal Project. This represents a direct effect on not only critical habitat but also the core habitat area being utilized by the sparrow within CSSS-D.

Examination of the recent 2009 to 2015 data compared to the previous (1992 to 2008) record (Table 6) indicates that there has been some loss of habitat in the optimal 90-210 day discontinuous hydroperiod range in subpopulations B (11 percent), C (5 percent), D (24 percent), and E (11 percent), possibly attributable to either recent wetter meteorological conditions or the construction and commencement of operations of nearby CERP components. This analysis also indicates that the amount of habitat in the optimal 90-210 day discontinuous hydroperiod range in subpopulation F has doubled from 26 to 53 percent over that same time period.

The physical and biological features or PCEs that are essential to the conservation of the Cape Sable seaside sparrow were documented as part of the CSSS Critical Habitat Designation (FR Vol. 72, 214). PCE 4 outlines "Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years." The analysis for gauges in CSSS-A and CSSS-C show exceedances of this metric over the period of record (Tables 17 and 18). In the last ten years, this PCE criterion has been exceeded more than 2 out of every 10 years in critical habitat in CSSS-C at the R3110, and E112 gauging sites (Table 18), with the 7.9 inch, 30 day criteria exceeded in 2009, 2010, 2012, and 2013. This provides further evidence that the period from 2009 through 2015 is indicative of wetter conditions.

The percentage of acreage meeting the criteria of 90 dry days within all critical habitat areas (B, C, D, E, and F) has decreased from 63 percent to 53 percent in CSSS-B, 91 percent to 71 percent in CSSS-C, 49 percent to 27 percent in CSSS-D, 63 percent to 44 percent in CSSS-E, and 94 percent to 85 percent in CSSS-F when comparing the record from 1992 to 2008 to the more recent 2009 to 2015 record, again possibly attributable to either wetter meteorological conditions or the construction and commencement of operations of nearby CERP components (Table 19).

Even though all subpopulations have demonstrated observable shifts in habitat or breeding conditions due to changes in hydrology, the Service has determined that CSSS critical habitat has not been adversely affected by changes in hydrology throughout the region and ERTP-2016 will not increase the risk of habitat loss.

3.2. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of listed species, their habitat (including designated critical habitat), and ecosystem within the action area. It is a “snapshot” of the species’ health and critical habitat conditions in the action area at the time of the consultation, and does not include the effects of the action under review.

Since the critical habitat of the CSSS is located entirely within the action there is no difference between the status of the critical habitat in the action area and the status of the critical habitat. Refer to the prior Status of the Critical Habitat section for details.

3.3. EFFECTS OF THE ACTION

A hydrologic model was used to evaluate potential adverse impacts to PCEs and designated critical habitat for the Cape Sable seaside sparrow. The model was developed to simulate conditions within critical habitat for the sparrow for the baseline condition and with project operations for the 1965 through 2005 period for each of the simulations. The PCEs for the Cape Sable seaside sparrow were described in the rule designating critical habitat (50 FR 62736), and discussed previously in this Biological Opinion. The PCEs include:

3.3.1. Calcitic marl soils

Marl soils are characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades and support the vegetation community on which sparrows depend. These soils result from specific hydrologic conditions that are characteristic of the marl prairie. Presently, soils in the marl prairie landscape within sparrow habitat vary in physical and chemical characteristics due to the variation in topography, hydrology, and vegetation (Sah et al. 2007). There currently are no methodologies upon which to evaluate the effects of project operations on soils; therefore, we rely on our hydrologic analyses that provide for marl prairies as surrogates for soils analyses.

3.3.2. Herbaceous vegetation

This PCE is characterized by greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species: muhly grass, Florida little bluestem, blacktopped sedge, and cordgrass. These plant species act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Many other herbaceous plant species also occur within sparrow habitat (Ross et al. 2006), and some of these play important roles in the life history of the sparrow (Sah et al. 2007).

Previous sections of the BO provided the Service's rationale for the 90-210 days discontinuous hydroperiod metric to measure effects on the plant community that provides sparrow habitat detailed in this PCE. The annual difference in hydrologic model simulations between the base and with-project scenarios for Units 1-5 (subpopulations B, C, D, E, and F) are provided in Table 35.

Based on this metric (Table 35), 127 acres (0.3 percent) of Unit 1 critical habitat, the largest and most populous CSSS critical habitat area, would be adversely affected by the proposed action. The analysis indicates that Unit 2 critical habitat would experience an average annual increase of 214 acres (+2.7 percent) meeting the optimal 90-210-day hydroperiod. Unit 3 critical habitat would experience an average annual decrease of 308 acres (-2.9 percent) meeting the optimal 90-210-day hydroperiod. Unit 4 critical habitat would experience an average annual decrease of 968 acres (-4.3 percent) meeting the optimal 90-210-day hydroperiod. Unit 5 critical habitat would experience an average annual decrease of 376 acres (-7.6 percent) meeting the optimal 90-210-day hydroperiod.

In summary, the analysis of model results indicates that across all CSSS critical habitat there would be an average annual decrease of 1,565 acres (1.8 percent of the total 84, 982 acreage) meeting the 90-210 day discontinuous hydroperiod. These acres are likely to experience a reduction in optimal vegetation communities due to changes in hydrology caused by the proposed project. However, the Service has determined that since the effects of the project as indicated by this metric will be minimal, (an average of -1.8 percent of the total critical habitat) the overall effect of the proposed project based on this PCE will not be adverse.

3.3.3. Contiguous open habitat

Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs and trees. The constituents of this PCE are largely predicated on a combination of hydroperiod and periodic fire events. Fires prevent hardwood vegetation from invading these communities and prevent the accretion of dead plant material, both of which decrease the suitability of this habitat type for Cape Sable seaside sparrows. Implementation of the proposed action could extend or reduce hydroperiods but cause a minimal effect on the occurrence of natural fires in the area. Establishment of woody vegetation in marl prairie habitat is often complicated by a variety of factors. Insufficient hydroperiod can favor woody vegetation which prefers shorter periods of inundation. Land elevation changes, such as levees, as well as nutrient loading can also influence the presence of woody vegetation. The proposed incremental operational changes of ERTP-2016 are intended to control excessive hydroperiod changes and thereby minimize changes in woody vegetative composition. Appreciable changes in this PCE within each critical habitat area are not anticipated.

3.3.4. Hydrologic regime

In order to maintain suitable vegetative composition conducive for successful nesting, it is important that water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years. Water depths greater than 7.9 inches (20 centimeters) during the breeding period can result in elevated nest failure rates (Lockwood et al. 2001; Pimm et al. 2002). If these water depths occur for short periods during nesting season, sparrows may be able to re-nest within the same season. These depths, if they occur for sustained periods (>30 days) within sparrow nesting season, may reduce successful nesting to a level that could be insufficient to support a population if it occurs more frequently than 2 out of every 10 years. This PCE was discussed previously in the context of its importance as an indicator of hydrologic conditions that would prevent flooding sparrow nests, maintain suitable conditions for sparrows occupying these areas, and generally support the vegetation species that are essential to sparrows.

The results of INCR2B and INCR2H model simulations for the 41-year period of record (1965-2005) for critical habitat Units 1-5 indicate that this metric is exceeded during 8 years in Unit 1, 20 years in Unit 3, 11 years in Unit 4 and 6 years in Unit 5 (Table 37). However, on average, less than 4 percent of critical habitat in individual sparrow subpopulations will be affected.

In summary the analysis based on this PCE shows that overall effects of the action as indicated by this metric, and based on model simulations, on critical habitat for all subpopulations will be minimal and confined to small areas that are not currently utilized by breeding sparrows.

3.3.5. Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The Service has addressed all interrelated and interdependent actions in the analysis of effects above. Therefore, there are no interdependent or interrelated actions associated with the proposed action that have not already been analyzed under the effects of the action, that are expected to affect CSSS designated critical habitat.

3.4. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological 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 Act.

Most of the lands included in designated critical habitat for the CSSS are federally owned and managed. Therefore, the majority of impacts to designated critical habitat are anticipated to be related to future Federal actions that will require a separate consultation under the Act.

3.5. CONCLUSION

Cape Sable Seaside Sparrow Designated Critical Habitat

The operation of the IOP during the interim period and the implementation of ERTP through January 1, 2016, was expected to remain consistent with previous operational plans and the RPA in the Service's 1999 Biological Opinion. Using newly available analytical tools, the extent of critical habitat that experiences a 90-210 day discontinuous hydroperiod that maintains habitat conditions for all phases of the CSSS life cycle has been determined to be deficient within the boundaries of many subpopulations. In addition, a number of studies have determined that vegetation change due to wetter conditions can occur rapidly, but recovery to healthy marl prairie vegetation in critical habitat is much slower (Sah et al. 2013, Armentano et al. 2006). Several studies have concluded that continued operation of water control structures and the resulting unnatural flow regimes in Cape Sable seaside sparrow critical habitat will continue to contribute to the decline in sparrow population, possibly resulting in extinction (Pimm et al. 2002, Walters et al. 2000). However, the PCEs as described for the designated critical habitat remain present across the landscape within each critical habitat unit.

No construction activities are proposed with the continued implementation of ERTP, since most of the structural features have already been constructed under IOP or are proposed under future projects, so there will be no direct impacts to sparrow critical habitat due to construction. Some minimal improvements in habitat conditions within limited areas of critical habitat in sparrow subpopulations C and F are likely to occur under ERTP-2016. Based on this information, the Service has determined that ERTP-2016 is not likely to destroy or adversely modify designated critical habitat for the Cape Sable seaside sparrow.

4. EVERGLADE SNAIL KITE

4.1. STATUS OF THE SPECIES

This section summarizes the effects of all past human and natural activities or events that have led to the current status of the Everglade snail kite and are relevant to formulating the biological opinion about the proposed action.

4.1.1. Legal Status

The Everglade snail kite is one of three subspecies of snail kite, a wide-ranging New World raptor found primarily in lowland freshwater marshes in tropical and subtropical America from Florida, Cuba, and Mexico south to Argentina and Peru. The Everglade subspecies occurs in Florida and Cuba, though only the Florida population is listed. The Florida population was first listed under the Endangered Species Preservation Act in 1967, and protection was continued under the Endangered Species Conservation Act of 1969. The Everglade snail kite (hereafter, snail kite), and all the other species listed under the Endangered Species Conservation Act of 1969 were the first species protected under the Act of 1973, as amended, and all of these species were given the 'endangered' status (32 FR 4001). Critical habitat for the snail kite was later designated in 1977 (50 CFR 17.95).

4.1.2. Species Description

The snail kite is a medium-sized raptor, with a total body length for adult birds of 14 to 15.5 inches and a wingspan of 43 to 46 inches (Sykes et al. 1995). In both sexes, the tail is square-tipped with a distinctive white base that appears as a white patch on the rump when in flight. The wings are broad, long, and paddle-shaped and are held bowed downward or cupped when in flight (Sykes et al. 1995). Adults of both sexes have red eyes and juveniles have brown eyes (Brown and Amadon 1976; Clark and Wheeler 1987). The plumage is markedly different among adult male, adult female, and juvenile birds. Adult males have a uniformly slate gray plumage, and adult female plumage is brown dorsally and pale white to cream ventrally, with dark streaking on the breast and belly (Sykes et al. 1995). Immature kites are similar in appearance to adult females, but are more cinnamon-colored, with tawny or buff-colored streaking rather than brown streaking. Females are slightly larger than males. A slender, decurved bill is an adaptation for extracting the kite's primary prey (*Pomacea* spp.), and is a distinguishing character for field identification in both adults and juveniles.

4.1.3. Life History

Breeding and Nesting Behaviors

Initiation, peak, and duration of the snail kite breeding season in Florida varies from year-to-year and are affected by water levels and climatic conditions (temperatures, precipitation). Ninety-eight percent of the nesting attempts are initiated from December through July, while 89 percent are initiated from January through June (Sykes 1987c; Beissinger 1988; Snyder et al. 1989), with the peak in nest initiation occurring from February to April (Sykes 1987c). Snail kites often re-nest following failed attempts early in the season as well as after successful attempts (Beissinger 1986; Snyder et al. 1989), with an observed maximum number of two successful broods within a breeding season (Bennetts et al. 1998). Analysis by Fletcher et al. (2015) indicates that average annual snail kite breeding season lengths have increased concomitantly with the exotic island apple snail (*Pomacea maculata*) invasion.

Pair bonds are established prior to egg-laying and are relatively short, typically lasting from nest initiation through most of the nestling stage (Beissinger 1986; Sykes et al. 1995). Male kites select nest sites, usually over water, and conduct most nest-building, which is probably part of courtship (Sykes 1987c; Sykes et al. 1995). Unlike most raptors, snail kites do not defend large territories and frequently nest in loose colonies or in association with wading bird nesting colonies (Sykes 1987b; Sykes et al. 1995). Kites actively defend small territories extending about 4 miles around the nest (Sykes 1987b). Copulation can occur from early stages of nest construction, through egg-laying, and during early incubation, if the clutch is not complete. Egg-laying begins soon after completion of the nest, but may be delayed a week or more (Sykes 1987c). An average 2-day interval between laying each egg results in the laying of a 3-egg clutch in about 6 days (Sykes et al. 1995). The clutch size ranges from one to five eggs, with a mode of three (Sykes 1987c; Beissinger 1988; Snyder et al. 1989). Incubation may begin after the first egg is laid, but generally after the second egg (Sykes 1987c). In Florida, the incubation period lasts 24 to 30 days (Sykes 1987c). Incubation is shared by both sexes, but the contribution of incubation time between the male and female is variable (Beissinger 1987). Hatching success is variable from year-to-year and between areas. In nests where at least one egg hatched, hatching success averaged 2.3 chicks per nest (Sykes 1987c).

After hatching, both parents initially participate in feeding young, but there is variability in the contribution of each member of the pair (Beissinger 1987). The nestling period lasts about 23 to 34 days and fledging dates may vary by 5 days among chicks (Sykes et al. 1995). Following fledging, young are fed by one or both adults until they are 9 to 11 weeks old (Beissinger 1987). In total, snail kites have a nesting cycle that lasts about 4 months from initiation of nest-building through independence of young (Beissinger 1986; Sykes et al. 1995).

Snail kites also have a relatively unique mating system in Florida that is described as ambisexual mate desertion, in which either the male or female may abandon nests part way through the nestling stage (Beissinger 1986, 1987). This behavior appears to occur primarily under conditions when prey is abundant, and it may be an adaptation to maximize productivity during favorable conditions. Following abandonment, the remaining parent continues to feed and attend chicks through independence (Beissinger 1986). Abandoning parents presumably form new pair bonds and initiate a new nesting attempt.

Snail kites mature early compared with many other raptors and can breed successfully the first spring after they hatch, when they are about 8 to 10 months old. However, not all kites breed at this age. Bennetts et al. (1998) reported that only 3 out of 9 first-year snail kites attempted to breed, while all 23 adults that were tracked attempted to breed. Reichert et al. (2012) evaluated breeding probabilities using marked birds, and found that annual breeding probabilities for after-hatch-year snail kites were generally low (around 0.17 during non-drought years). Annual breeding probabilities for this group increased during drought years to 0.48, which, given that adult breeding probabilities declined during drought years, probably reflects inexperience in young kites or density dependence in breeding opportunities (Reichert et al. 2012). In contrast, reproductively active adult snail kites, breeding probabilities averaged 0.87 during non-drought years and 0.62 during drought. Annual breeding probabilities vary among snail kites based on environmental conditions and individual characteristics (*e.g.*, fitness, previous breeding experience), but are significantly <1 (Reichert et al. 2012). During severe drought years, a large portion of the population (~30-70 percent [Reichert et al. 2012], up to 80-90 percent [Beissinger 1986]) may not attempt to breed. In addition, non-breeding (potentially less fit) adults were unlikely to breed in the following year (probability ≤ 0.10; Reichert et al. 2012). The oldest confirmed breeding snail kite in Florida is 24 years (Reichert et al. 2015), and the maximum lifespan of a snail kite in the wild is at least 25 years (Reichert et al. 2010).

Diet and Feeding Behavior

Snail kites are dietary specialists, a relatively rare foraging strategy among raptors. Throughout the range of all subspecies of snail kites, apple snails (*Pomacea* spp.) consistently compose the primary prey of snail kites, who possess several unique adaptations that allow them to efficiently capture, extract, and consume the snails (*e.g.*, the slender, deeply hooked, sharp-tipped bill that allows kites to efficiently extract snails from their shells; long slender toes that allow kites to grasp large snails) (Sykes 1987a; Sykes et al. 1995; Beissinger 1990). Historically, snail kites in Florida foraged primarily on the Florida apple snail (*P. paludosa*), which is the only species of *Pomacea* native to North America (Sykes 1987b; Rawlings et al. 2007). Several species of non-native apple snails have recently become established within the snail kite's range in Florida. Of these, *P. maculata* is commonly eaten by snail kites, and in some wetlands composes the vast majority of the snail kite's forage base. These highly invasive exotic snails are larger, more fecund, and more drought tolerant, and have faster growth rates and longer life spans than Florida apple snails (Ramakrishnan 2007; Kyle et al. 2013; Horgan et al. 2014). Because of these factors, *P. maculata* has the potential to influence a wide variety of snail kite behaviors and demographic rates, both positively and negatively, through direct and indirect pathways (Fletcher et al. 2015; see Invasive Nonnative Species under Threats to the Species).

Under normal conditions, snail kites are nearly completely dependent on apple snails as prey. However, other prey items have been documented, especially during periods of limited prey availability, such as drought conditions or cold spells. Beissinger (1990) reported that kites captured and consumed small turtles, such as the musk turtle (*Sternotherus odoratus*) and mud turtles (*Kinosternon* spp), and they captured and consumed another type of small freshwater snail (*Viviparus georgianus*). Other prey that have been occasionally documented include crayfish (*Procambarus* spp.), speckled perch (*Pomoxis nigromaculatus*), and small snakes (Sykes et al. 1995).

Snail kites use two visual foraging methods: course-hunting, while flying 5 to 33 ft above the water surface, or still-hunting from a perch (Sykes 1987a; Sykes et al. 1995). In Florida, course-hunting is more frequent than still-hunting; still-hunting may be limited by perch availability or prey abundance (Cary 1985; Valentine-Darby et al. 1998). While course-hunting, the flight is characterized by slow wing beats alternating with gliding; the flight path is usually into the wind, with the head oriented downward to search for prey. Snails are captured with the feet at or below the surface, to a maximum reach of about 6 inches below the surface. Snail kites do not plunge into the water to capture snails and never use the bill to capture prey. Individuals may concentrate hunting in a particular foraging site, returning to the same area as long as foraging conditions are favorable (Cary 1985). Capture rates are higher in summer than in winter (Cary 1985), with no captures observed at a temperature less than 10°C (50°F). Snail kites frequently transfer snails from the feet to the bill while in flight to a perch. Feeding perches include living and dead woody-stemmed plants, blades of sawgrass (*Cladium jamaicense*) and cattails (*Typha* spp.), and fence posts. Snail kites are gregarious and may forage in common areas in proximity to other foraging kites.

Non-breeding snail kites may fly long distances over the course of days or months while tracking prey resources across the landscape (Bennetts and Kitchens 2000). Nesting snail kites often forage within 1-2 km of their nests under favorable conditions, but have been observed traveling more than 6 km to find snails to feed young (Beissinger and Snyder 1987).

Pias (2012) found a negative relationship between foraging rates and home range size on Lake Tohopekaliga (Toho), suggesting that smaller home ranges may have higher densities of available snails. However, foraging rates were not significantly different between parents of successful nests and those of failed nests (Pias 2012). Similarly, analyses investigating the effect of foraging rates on snail kite reproductive parameters did not show a strong association (Fletcher et al. 2015). Reasons for this may include over-riding factors (*e.g.*, predation, environmental factors) that have a greater effect on reproductive success, or a potential foraging/snail density threshold above which there is low variation in foraging rates and below which kites will not stay to forage (Reichert et al. 2010; Darby et al. 2012, Olbert 2013, Fletcher et al. 2015).

4.1.4. Habitat and Hydrologic Requirements

Snail kites and apple snails are wetland-dependent species and rely on wetland habitats for all aspects of their life histories. The primary wetland habitat types upon which kites rely consist of freshwater marshes and the shallow-vegetated littoral zones along the edges of lakes (natural and man-made) where apple snails occur in relatively high abundance and can be found and captured by kites. Within these habitats, water levels and recession/ascension rates can affect snail kite and apple snail reproductive efforts and success.

Nesting Habitat

Nesting almost always occurs over water, which deters predation (Sykes 1987b). An important feature for snail kite nesting habitat is the proximity of suitable nesting sites to favorable foraging areas. Thus, extensive stands of contiguous woody vegetation are generally unsuitable for nesting, whereas suitable nest sites consist of single trees or shrubs or small clumps of trees and shrubs within or adjacent to an extensive area of suitable foraging habitat. Trees usually less than 32 ft tall are used for nesting include willow (*Salix* spp.), bald cypress (*Taxodium distichum*), pond cypress (*Taxodium ascendens*), *Melaleuca quinquenervia*, sweetbay (*Magnolia virginiana*), swamp bay (*Persea borbonia*), pond apple (*Annona glabra*), and dahoon holly (*Ilex cassine*). In some cases, snail kites also nest in crowns of living cabbage palms (*Sabal palmetto*) which may be present in recently or infrequently flooded areas. Shrubs used for nesting include wax myrtle (*Myrica cerifera*), cocoplum (*Chrysobalanus icaco*), buttonbush (*Cephalanthus occidentalis*), *Sesbania* spp., elderberry (*Sambucus simpsonii*), and Brazilian pepper (*Schinus terebinthifolius*). Nesting also can occur in herbaceous vegetation, such as sawgrass, cattail, bulrush, and reed (*Phragmites australis*) (Sykes et al. 1995). Nesting in lake littoral zones, especially those of the Kissimmee Chain of Lakes, is often observed in herbaceous vegetation. Nests constructed in herbaceous vegetation on the waterward side of the lakes' littoral zone are more vulnerable to collapse due to the weight of the nests, wind, waves, and boat wakes and are more exposed to disturbance by humans (Chandler and Anderson 1974; Sykes and Chandler 1974; Sykes 1987b; Beissinger 1986, 1988; Snyder et al. 1989).

Impacts of seasonal water levels and transitions on nesting snail kites and their habitat are discussed more below (see Incompatible Water Management and Nest Predation under Threats to the Species), and WCA-3A-specific impacts and targets are discussed in detail in the Environmental Baseline section of this Biological Opinion.

Foraging Habitat

While kites are capable of foraging successfully under a variety of habitat conditions, the preferred foraging habitat is typically a combination of relatively short-stature, sparse graminoid marsh vegetation less than 6.5 ft in height. The apple snail requires emergent aquatic plants to provide substrate that allows them to reach the water surface to breathe. However, for kites to feed, the emergent vegetation must be sparse enough that they are capable of locating and capturing snails (Kitchens et al. 2002). Snail availability is influenced by both vegetation structure and water depth. Marshes, wet prairies, and lake littoral zones composed of interconnected areas of open water 0.6 to 4.3 ft deep which are relatively clear and calm and patches of herbaceous emergent wetland plants or sparse continuous growth of herbaceous wetland plants generally provide the appropriate balance of emergent vegetation and open water (Sykes et al. 1995; Kitchens et al. 2002). Marsh species that commonly occur within favorable kite foraging habitat include spike rush (*Eleocharis cellulosa*), maidencane (*Panicum hemitomon*), sawgrass, bulrush (*Scirpus* spp.), and/or cattails. Shallow open-water areas may also contain sparse cover of species such as white water lily (*Nymphaea odorata*), arrowhead (*Sagittaria lancifolia*), pickerel weed (*Pontederia lanceolata*), and floating heart (*Nymphoides aquatica*). Snail kites also forage in deeper water in lacustrine habitats dominated by submergent or floating-leaved vegetation (Pias 2012). Periphyton growth on the submerged substrate provides food source for apple snails, and submergent aquatic plants, such as bladderworts (*Utricularia* spp.) and eelgrass (*Vallisneria* spp.), may contribute to favorable conditions for apple snails while not preventing kites from detecting snails (Sykes et al. 1995).

Using field data from 1995 to 2004, Darby et al. (2006) estimated that snail densities less than 0.14 individuals per square-meter are unable to support kite foraging. To manage for sufficient densities, Darby et al. (2009) recommended a range of water depths between 4 and 20 inches during the peak apple snail breeding period between April and June. Deeper water can delay or reduce apple snail egg cluster production, while shallower water can prevent snail movement and breeding, also resulting in decreased egg cluster production and subsequently lower snail densities.

Foraging habitat conditions that differ substantially from those described above will result in either reduced apple snail density or reduced ability of snail kites to locate and capture snails. Vegetation cover that is either too dense or too sparse can result in reduction in the quality of the area as foraging habitat. Impacts of seasonal water levels and transitions on apple snails, foraging snail kites, and their habitat are discussed more below (see Incompatible Water

Management under Threats to the Species), and WCA-3A-specific impacts and targets are discussed in detail in the Environmental Baseline section of this Biological Opinion.

Roosting Habitat

Outside of the breeding season, snail kites may roost communally, usually over water, in groups of up to 400 or more individuals (Bennetts et al. 1994). Roost sites are typically in taller vegetation among low profile marshes. On average, in Florida, 91.6 percent of roost sites are located in willows, 5.6 percent in melaleuca, and 2.8 percent in pond cypress. Snail kites tend to roost around small openings in willow stands at a height of 5.9 to 20.0 ft, in stand sizes of 0.05 to 12.35 acres. Roosting also has been observed in melaleuca or pond cypress stands with tree heights of 13 to 40 ft (Sykes 1985).

4.1.5. Distribution and Movement

Historic and Current Distribution

The subspecies *R. s. plumbeus* occurs in Florida, Cuba (including Isla de la Juventud), and northwestern Honduras. There is no evidence of movement of birds between Cuba and Florida, but this possibility has not been ruled out (Sykes 1979; Beissinger et al. 1983). A recent genetic survey of the three known subspecies of snail kites conducted by Haas et al. (2009) indicated that there are no genetic differences between the Florida and Cuba populations of *R. s. plumbeus*. However, due to their small sample size, additional studies would be needed to confirm these results in order to make proper inference regarding the possibility of employing translocation as a viable recovery action for the species.

In Florida, the historic range of the snail kite was larger than at present. The current distribution of the snail kite in Florida is limited to central and southern portions of the State. Six large freshwater systems are located within the current range of the snail kite: Upper St. Johns marshes, the Kissimmee Chain of Lakes (KCOL), Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin (Beissinger and Takekawa 1983; Sykes 1984; Rodgers et al. 1988; Bennetts and Kitchens 1997; Rumbold and Mihalik 1994; Sykes et al. 1995; Martin et al. 2006a). Other areas that have supported snail kites include the East Orlando Wilderness Park, the Blue Cypress Water Management Area, the St. Johns Reservoir, and the Cloud Lake, Strazzulla, and Indrio impoundments, with most current nesting occurring only within the Blue Cypress Water Management Area, also referred to as the St. Johns Marsh (Martin et al. 2006a). In the KCOL, snail kites may occur within most of the lakes and adjacent wetlands, with the majority of snail kite nesting occurring within Lake Kissimmee, Lake Toho, and East Lake Toho. In the KCOL, snail kites have also nested in lower numbers on Lakes Hatchineha and Jackson. Snail kite nesting, sometimes in relatively large numbers, has occurred periodically since about 2002 in Lake Istokpoga. Lake Okeechobee and surrounding wetlands represent significant snail kite nesting and foraging habitats that have historically supported snail kites. In the Loxahatchee Slough region of Palm Beach County, snail kites may occur in the Loxahatchee National Wildlife Refuge (NWR; WCA-1) and throughout the remaining marshes in the vicinity, most frequently nesting within Grassy Waters, also known as the West Palm Beach Water

Catchment Area. Snail kites may occur within nearly all remaining wetlands of the Everglades region, with recent nesting occurring within WCA-2B, WCA-3A, WCA-3B, and ENP (Martin et al. 2006a). Within the Big Cypress basin, snail kites may occur within most of the non-forested and sparsely forested wetlands; nesting was last documented in this area in 2012.

Lake Okeechobee is of particular importance since it serves as a critical stopover point as snail kites traverse the network of wetlands within their range. A loss of suitable habitat and refugia, especially during droughts in the lake, may have significant demographic consequences (Takekawa and Beissinger 1989; Kitchens et al. 2002; Martin et al. 2006a). Lake Okeechobee will be critical to the snail kite's long-term population persistence, especially given the susceptibility of juvenile snail kites in the Kissimmee River Valley to an increased frequency of local disturbance events due to cold weather and the treatment of hydrilla (*Hydrilla verticillata*) (Reichert et al. 2011). Once a productive breeding site, Lake Okeechobee made only minor contributions to the snail kite population in terms of reproduction from 1996 to 2006 (Cattau et al. 2008a). The loss of suitable snail kite foraging and nesting areas within Lake Okeechobee was attributed to shifts in water management regimes (Bennetts and Kitchens 1997), along with habitat degradation due to hurricanes (Cattau et al. 2008a). Most of the nesting in Lake Okeechobee prior to 2007 had occurred within the expansive marsh in the southwestern portion of the lake and the area southwest of the inflow of the Kissimmee River (Martin et al. 2006a). However, there was no nesting within Lake Okeechobee from 2007 to 2009 and only limited nesting in 2010 within portions of the lake that are outside of the historic nesting areas. The 2010 nesting occurred in two general areas: (1) the littoral zone from just west of where the Kissimmee River enters the lake northward to the city of Okeechobee, including Eagle Bay Marsh and (2) near Observation Island, located along the open water edge of the littoral zone in the southwest portion of the lake. Since 2010, water levels in the lake have generally been lower and aquatic vegetation has improved in the lake, resulting in increased snail kite nesting efforts (Fletcher et al. 2015).

WCA-3A was once an important snail kite foraging and nesting area. Historically, the WCAs, and WCA-3A in particular, have fledged, proportionally, the large majority of young in the region. However, no young were fledged in WCA-3A in 2001, 2005, 2007, 2008, 2010, or 2012. The decline in breeding activity and success observed in WCA-3A over recent years may reflect deteriorating habitat quality as well as significantly decreased prey abundance. Although the overall trend in WCA-3A has been down, a slight increase in nesting attempts in 2013 and 2014 may indicate a positive change in prey densities or suitable habitat, although nesting effort was down again 2015.

The shift in dependence from Lake Okeehobee and the WCAs to the KCOL was apparent as reproduction within this watershed has accounted for 52, 12, 89, 72, and 61 percent of the successful nesting attempts range-wide in 2005, 2006, 2007, 2008, and 2009, respectively (Cattau et al. 2009). Lake Toho accounted for 41 percent of all successful nests and 57 percent of all fledged young that were documented on a range-wide basis from 2005-2010 (Fletcher et al. 2015). In 2011, strong breeding occurred again on Lake Toho as well as an unprecedented amount of nesting on East Toho. In 2011, nesting on Lakes Toho and East Toho accounted for a total of 76 percent of successful nests and 81 percent of fledged young rangewide (Fletcher

2015a). While East Toho was again heavily utilized by breeding snail kites in 2012 (24 percent of successful nests and 25 percent of fledged young rangewide), nesting on Lake Toho decreased (although still accounting for 31 percent of all successful nests and 30 percent of fledged young rangewide)(Fletcher 2015a). From 2013 on, the contribution of Lake Toho nesting compared to nesting rangewide has decreased markedly, primarily due to increased utilization of Lake Okeechobee as well as other areas including the STAs. Fletcher et al. (2015) hypothesized it could be due to changes in KCOL habitat conditions rather than simply from improving conditions elsewhere attracting breeding snail kites. In addition, nest success in Lake Toho dropped considerably in 2014 (26 percent in 2014 compared to 44-51 percent in the preceding three years; Fletcher 2015a). The cause of this is not yet known but may be related to decreased habitat suitability on the lake, including impacts to snail densities or availability.

Since 2010, snail kites have also nested in the Everglades Stormwater Treatment Areas 1, 3, and 5, with the majority of nesting occurring in STA 5. According to Fletcher (2016), "Nesting effort in STAs 1, 3, and 5 increased annually from 0% in 2012, to 13% in 2013, and 32% in 2014, but decreased in 2015 to 19%."

In addition to the primary wetlands discussed above, there are numerous records of snail kite occurrence and nesting within isolated wetlands throughout the region. In the 1990's, Sykes et al. (1995) observed snail kites using smaller, more isolated wetlands including the Savannas State Preserve in St. Lucie County, Hancock Impoundment in Hendry County, and Lehigh Acres in Lee County. Takekawa and Beissinger (1989) identified numerous wetlands that they considered drought refugia, which may provide snail kite foraging habitat when conditions in the larger more traditionally occupied wetlands are unsuitable. Radio tracking and satellite telemetry of snail kites has also revealed that the network of habitats used by the species includes many smaller, widely dispersed wetlands within this overall range (Bennetts and Kitchens 1997; Meyer 2015). Snail kites may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. For example, 2010 snail kite nesting surveys documented nesting in surprisingly high numbers in peripheral areas such as Harns Marsh, in Lehigh Acres. That year, a snail kite nest and juveniles were also observed for the first time in the S-332D detention area in eastern ENP, also known as the Frog Pond. WCA-3B also contributed fledglings in both 2013 and 2014. In 2015, a large number of nests (most of them successful) were found in a new area, Mary A Mitigation Bank in Brevard County, and one successful snail kite nest was found on Lake Smart in Polk County. In addition, reports of foraging snail kites have been increasing in Polk County as well as Sarasota County.

Movements

Snail kites have generally been considered nomadic, probably responding to changing hydrologic conditions (Sykes 1979). During the breeding season, kites remain close to their nest sites until they fledge young or fail. Following fledging, adults may remain around the nest for several weeks, but once young are fully independent adults may depart the area. Outside of breeding season, snail kites regularly travel long distances within and among wetland systems in southern Florida (Bennetts and Kitchens 1997). While most movements may be in response to droughts or other unfavorable conditions, kites may also move away from wetlands when conditions appear favorable. Movements within large wetlands and movements among adjacent wetland units occurred frequently, while movements among spatially-isolated wetlands occurred less frequently (Martin et al. 2006). Fledgling kites also move frequently, but are more likely to move to immediately adjacent wetland units than adults, which may indicate a degree of familiarity with the availability of wetlands across the landscape that adult kites acquire through experience.

Between breeding seasons, Fletcher et al. (2015) found a high degree of site and regional philopatry for breeding snail kites. This pattern was observed as both natal and breeding philopatry. Natal philopatry reflects the proportion of 1-year old (or 2-year old, given many 1-year old birds do not attempt to breed) birds that have their first nesting attempt in the wetland that they were born in, whereas breeding philopatry reflects the likelihood that adult birds will breed in the same site (or region) that they previously were observed to breed in. These results indicate the importance of distinguishing and interpreting movement associated with reproduction (dispersal) versus more nomadic non-breeding movements (*e.g.*, foraging that tracks variation in food availability). Analysis results of Fletcher et al. (2015) show that regional philopatry has been very high for the Kissimmee River Valley (northern region) and the Everglades (southern region); immigration between these and other portions of the population between breeding seasons still occurs, but at lower rates (Figure 20). In contrast, Lake Okeechobee and the STAs, being centralized, appear to serve as “mixing grounds” and “stepping stones” for nesting birds. This information suggests that the snail kite population in Florida is currently experiencing significant spatial structuring; however, based on the amount of immigration occurring between regions, it is premature to consider these as separate subpopulations.

4.1.6. Population Dynamics

Population Size

Several authors (Nicholson 1926; Howell 1932; Bent 1937) indicated that the snail kite was numerous in central and southern Florida marshes during the early 1900s, with groups of up to 100 birds. Reports of snail kite population declines in the 1940s and 1950s suggested that as few as 6 to 100 individuals remained (Sykes 1979). When the snail kite was listed as endangered in 1967, the species was considered to be at an extremely low population level. In 1965, only 10 birds were found – 8 in WCA-2A and 2 at Lake Okeechobee. A survey in 1967 found 21 birds in WCA-2A (Stieglitz and Thompson 1967). Relatively large fluctuations in the snail kite population size have been widely reported and generally attributed to environmental conditions (Beissinger 1986; Beissinger 1995; Martin et al. 2006a; Cattau et al. 2008a). It is unclear whether the reports of declines were completely from a loss in the number of individuals or a result of the snail kite’s nomadic behavior, limited survey efforts, and the lack of biological knowledge of the species. As it was not known at the time that snail kites are nomadic in response to unfavorable hydrologic conditions (Sykes 1979), it is possible the surveys were documenting more the absence of snail kites from their usual locations, including Lake Okeechobee and the headwaters of the St. John’s marsh (Sykes 1979), and not entirely from the actual loss of individual snail kites. In addition, limited resources were available at that time for researchers to reach potential snail kite habitats. As such, the resulting low level of survey effort may have biased these low snail kite population estimates. Rodgers et al. (1988) have stated that it is unknown whether decreases in reported snail kite numbers in the annual count were due to mortality, dispersal (into areas not counted), decreased productivity, or a combination of these factors. However, there is little doubt that the snail kite was endangered at the time of its listing and that its range had been dramatically reduced.

Prior to 1969, the snail kite population was monitored only through sporadic and inconsistent surveys (Sykes 1979, 1984). From 1969 to 1994, an annual quasi-systematic, mid-winter snail kite count was conducted by a succession of principal investigators, with counts ranging from a low of 65 snail kites in 1972 to a high of 996 snail kites in 1994 (Sykes 1979; Sykes 1983a; Beissinger 1986; Bennetts et al. 1999). Bennetts et al. (1993, 1994) cautioned that the 1993 and 1994 counts were performed with the advantage of having numerous birds radio-tagged. This likely increased the total count because radio-tagged birds could easily be located and often led researchers to roosts that had not been previously surveyed. Bennetts and Kitchens (1997) identified issues with the count surveys and recommended that they should not be the basis of population estimates or used to infer demographic parameters such as survival or recruitment. Bennetts et al. (1999a) analyzed these counts and the sources of variation in these counts and determined that count totals were influenced by differences in observers, survey effort, hydrologic conditions, and site effects. While significant sources of error were identified, these data could provide a crude indication of trends if one assumes all influences of detection rates had been adequately taken into account. Because this is highly unlikely, the sources of variation in the counts should be recognized prior to using these data in subsequent interpretations, especially in attempting to determine population viability and the risk of extinction.

Beginning in 1997, refined population estimates were generated for the snail kite using a mark-recapture method (Dreitz et al. 2002). These new population estimates, which incorporate detection probability (less than 1.0), were higher than those resulting from the previous counts. Population size estimates generated from mark-recapture techniques for 1997 to 2000 are approximately 2 to 3 times higher than previous count-based estimates (*e.g.*, 800 to 1,000 estimated snail kites based on count-based surveys in 1993 and 1995, compared to an estimated 2,700 to 3,500 snail kites based on mark-recapture analyses from 1997 to 2000) (Bennetts and Kitchens 1997; Dreitz et al. 2002). Confidence intervals could also be generated for population estimates generated using the new method, which increased the validity of comparing population estimates among years.

Since 1997, population estimates and estimates of demographic parameters have been generated exclusively employing mark-recapture methods that incorporate detection probabilities (Figure 21). From 1997 through 1999, the snail kite population was estimated to be approximately 3,000 birds (Dreitz et al. 2002). From 1999 through 2002, the population estimates declined each year until they reached a low level of approximately 1,400 birds in 2002 and 2003, then increased slightly to about 1,700 birds in 2004 and 2005 (Martin et al. 2006a). The snail kite population exhibited steep declines in both 2007 and 2008, with estimates of 1,204 birds and 685 birds, respectively, but rebounded slightly starting in 2010. The 2012 population estimate was 1,218 birds (Cattau et al. 2012). The 2013 population estimate was similar – 1,198 birds (Fletcher et al. 2014). In 2014, the population estimate was significantly higher (1,754 birds [95 percent CI = 1605-1897]) primarily due to stable fledging rates in Lake Okeechobee and an increase in fledging in the Everglades and STAs (Fletcher et al. 2015).

Demographic Rates

Snail kites appear to exhibit high levels of variability in many demographic parameters, while others remain relatively constant. Adult snail kite survival appears to be relatively constant over time at a relatively high level (>80 percent) (Bennetts et al. 1999; Martin et al. 2006; Cattau et al. 2009). Adult survival is probably reduced in drought years (Takekawa and Beissinger 1989; Martin et al. 2006), as was observed by the appreciable drops from 2000 through 2002, and again from 2006 through 2008 (Figure 22). These temporary low adult survival rates coincided with significant declines in the overall population associated with region-wide droughts during 2001 and 2007. Researchers have also observed geographic variation of adult snail kite survival rates, with higher rates in southern relative to northern regions of their range (Martin et al. 2006, Martin et al. 2007, Fletcher et al. 2015).

In contrast to relatively constant adult survival estimates, juvenile survival appears to be highly variable among years, reaching a record low in 2002 (Figure 22) (Beissinger 1995; Bennetts and Kitchens 1999; Martin et al. 2003; Martin et al. 2006a; Cattau et al. 2009). The observed variability in juvenile survival is likely related to variation in environmental conditions, including those hydrologic conditions that directly affect the survival and productivity of the apple snail.

Other variable demographic parameters such as distribution of nesting and productivity are also likely driven by annual variability of environmental factors, most notably apple snail density and availability (which in turn, are affected by prevailing and previous year water levels). Duration of the breeding season and amount of double-brooding are also variable (Beissinger 1986). Under favorable environmental conditions, snail kites have the ability to achieve high reproductive rates (Beissinger 1986), and similarly, juvenile survival rates appear to be higher under more favorable conditions.

The observed declines in the snail kite population from 1999 to 2002 (Figure 21) coincided with a regional drought that affected central and south Florida during 2000 to 2001. During this period, nest success was generally low, and demographic parameters estimated using mark-recapture methods indicated low juvenile survival rates (Martin et al. 2006a). Despite the return to normal or wetter-than-normal hydrologic conditions from 2002 to 2006, which generally provide favorable snail kite nesting conditions, population estimates remained low, and nest success and juvenile survival rates also remained low (Martin et al. 2006a). Additionally, snail kite nesting ceased in WCA-3A due to the 2004 crash of the native apple snail population there caused by extended high water conditions during the snail breeding season. Nest success and number of young fledged increased slightly in 2007 and 2008 (Cattau et al. 2009), despite severe drought conditions in 2007. Juvenile survival significantly increased from 0.226 in 2006 to 0.558 in 2007, then decreased again to 0.381 in 2008 (Cattau et al. 2009). Conversely, adult survival decreased significantly in 2007 from 0.834 to 0.538, then rebounded to 0.826 in 2008

(Cattau et al. 2009). These irregularities are likely a result of the increased utilization of the KCOL, where a majority of young fledged in 2007. Historically, water levels in KCOL have been less affected by adverse drought conditions (Bennetts and Kitchens 1997).

Table 20 shows that over the last six years (from 2009 to 2014) that the number of successful snail kites nests and number of fledglings has generally increased rangewide (where sampling occurs). Since 2011, nesting efforts and success on Lake Okeechobee have improved drastically – Lake Okeechobee was the most productive water body in terms of overall snail kite production during 2013, and the observed number of fledglings from the lake has been 43 and 39 birds in 2013 and 2014, respectively (Fletcher 2015a). There was also a marked increase in nesting attempts in WCA-3A in 2013 and 2014 (36 active nests each year), with 14 and 30 fledged young observed, respectively (Fletcher 2015a).

Although estimates of apple snail populations are not available across the snail kite's range or during all years, available information regarding apple snail occurrence and abundance within traditional snail kite nesting areas also show that foraging conditions have varied over the last 15 years.

Trends

Recent population estimates are 2 to 3 times more accurate than those produced prior to 1997 owing to the improved mark-resighting method first applied in 1997-2000 and refined in 2002 (Dreitz 2000; Dreitz et al. 2002). While it is not possible to compare the current population size to those recorded from the 1970s through 1997 due to differences in sampling methods, several lines of evidence suggest that the current snail kite population declined drastically from 2000 to 2008. Two major reductions in numbers occurred following region-wide droughts in 2001 and 2007 (Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008a). The snail kite population estimate dropped by more than 75 percent during this time, from an estimate of approximately 3,400 birds in 1999 to fewer than 700 in 2008 and 2009 (Figure 21; Cattau et al. 2009). Concurrent with the apparent population declines, number of nesting attempts, nest success, and the number of young fledged, particularly in wetlands such as Lake Okeechobee and the WCAs historically used by breeding kites, also generally declined (Fletcher et al. 2015). Recent retrospective analyses by Fletcher et al. (2015) indicate the population decline was largely driven by reduced contributions of these southern regions to total population growth.

Since 2009, snail kite population growth has been consistently positive (four out of the last five years), which marks a period of population recovery (Fletcher et al. 2015). This overall trend has been driven by increased contributions from the Kissimmee Chain of Lakes since 2005, and is due primarily to increases in reproduction and juvenile recruitment (Fletcher et al. 2015). Both of these demographic parameters have been positively linked to the invasion of *Pomacea maculata* as discussed below (see Invasive Nonnative Species under Threats to the Species). However, during this recovery period, dispersal has become increasingly limited between the northern and southern regions (Fletcher et al. 2015). Such limited dispersal highlights the importance of suitable local demographic rates and, for the southern region, quality breeding and foraging habitat in "stepping stone" wetlands to maintain the population into the future.

Population Viability Analysis

Based on demographic parameters generated using mark-recapture methodology, a population viability analysis (PVA) for the snail kites was conducted in 2006. This PVA indicated there was a high probability of quasi-extinction (identified as ≤ 50 female snail kites) within the next 50 years if current reproduction, survival, and drought frequency rates remained the same as those observed from 1996 to 2006 (Martin et al. 2007; Cattau et al. 2008a, 2009). Quasi-extinction risk is the probability of a population falling below a critical density – an extremely undesirable population level that may be unlikely to be recoverable even with drastic management steps, such as captive breeding. In 2010, snail kite researchers conducted a new PVA which updated the demographic parameters and incorporated effects of variable environmental (hydrologic) states. According to Cattau et al. (2012), preliminary results from this PVA "predict a 95 percent probability of population extinction within 40 years." They further state, "These results are especially concerning, as they indicate an increased risk of extinction when compared to results from a previous PVA conducted in 2006. Recent analyses also provide indications of an aging population with problems inherent to older individuals, including increased adult mortality rates and decreased probabilities of attempting to breed, both of which have been shown to be exacerbated during times of harsh environmental conditions" (Cattau et al. 2012).

More recent analyses conducted by Fletcher et al (2015) indicated population growth rates near or above 1.0 when exotic snail effects were included in demographic rates, compared to 0.974 and 0.925 under scenarios without *Pomacea maculata* effects. Their retrospective analysis showed an increasing trend in the contribution of juvenile recruitment to population growth rate in the northern region. Based on per capita contributions, the northern region was a population source five out of seven years from 2007-2013, primarily due to this increase in local recruitment. Conversely, per capita contribution for the southern region has been <1.0 for all but 4 years during the 18 year study duration, and the highest contribution to population growth rate in the southern region was from surviving adults (not immigrants). Declines in per capita contribution of local adult survival in the southern region were not offset by increases to emigration from the northern region (Fletcher et al. 2015).

4.1.7. Threats to the Species

There are a variety of threats that have been identified which can affect snail kite nesting, foraging, and survival. These threats include loss and degradation of wetland habitat, incompatible water management, nest predation, invasive nonnative species, potential disease and contaminants concerns, human disturbance, and environmental stochasticity (***e.g.***, extreme weather events).

Habitat Loss and Degradation

The principal threat to the snail kite is the loss, fragmentation, and degradation of wetlands in central and southern Florida resulting from urbanized and agricultural development and alterations to wetland hydrology through ditching, impoundment, and water level management. Nearly half of the Everglades have been drained for agriculture and urban development (Davis and Ogden 1994; Corps 1999). The Everglades Agricultural Area (EAA) alone eliminated 3,100 square-miles of the original Everglades and the urban areas in Miami-Dade, Broward, and Palm Beach Counties have contributed to the reduction of habitat. North of ENP, which has preserved only about one-fifth of the original extent of the Everglades, the remaining marsh has been fragmented into shallow impoundments (*i.e.*, WCAs). The Corps' C&SF Project encompasses 18,000 square-miles from Orlando to Florida Bay and includes about 994 miles each of canals and levees, 150 water control structures, and 16 major pump stations. This system, which was originally designed and constructed to serve flood control and water supply purposes, has disrupted the volume, timing, direction, and velocity of freshwater flow and has resulted in habitat loss and degradation in the WCAs and other portions of the historic Everglades. Drainage of Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail and the snail kite (Sykes 1983b). Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once kite habitat.

Habitat loss and fragmentation are also factors influencing survival during droughts, despite the species' dispersal ability (Martin et al. 2006). As discussed above, the snail kite may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. In dry years, snail kites depend more on water bodies that normally are suboptimal for feeding, such as canals, impoundments, or small marsh areas, remote from regularly used sites (Beissinger and Takekawa 1983; Bennetts et al. 1988; Takekawa and Beissinger 1989). The fragmentation or loss of wetland habitat significantly limits the snail kites' ability to be resilient to disturbance events such as various climatic events. As wetland habitats become more fragmented, the dispersal distances become greater, putting increased stress on dispersing kites that may not be able to replenish energy supplies.

Degradation of wetland habitat, particularly due to water quality impacts associated with runoff of phosphorus from agricultural and urban sources, is another concern for the snail kite. The Everglades was historically an oligotrophic system (*i.e.*, having a deficiency of plant nutrients that is usually accompanied by an abundance of dissolved oxygen), but major portions have become eutrophic (*i.e.*, rich in nutrients and so supporting a dense plant population, the decomposition of which may kill aquatic animal life by depriving it of oxygen), primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Most of this increase has been attributed to non-point source runoff from agricultural lands north of Lake Okeechobee, in the Kissimmee River, Taylor Slough, and Nubbin Slough drainages (Federico et al. 1981). Elevated phosphorus concentrations and loads in the Everglades have long been associated with increases in cattail expansion, which may influence the critical habitat for the snail kite. In lacustrine environments, cultural eutrophication also is a concern, especially in the KCOL. Nutrient enrichment leads to growth of dense stands of herbaceous emergent vegetation and floating vegetation (primarily water hyacinth [*Eichhornia crassipes*] and water lettuce [*Pistia stratiotes*]), which inhibit the ability of snail kites to forage along the shorelines of lake areas. Large areas of marsh are also heavily infested with water hyacinth, which inhibits the kite's ability to see its prey (Service 2007d). The Service is not aware of any scientific investigations that directly relate effects of differing nutrient concentrations to the reproductive success of snail kites; however, there is a weight of evidence that indicates that most of the lakes and large areas of Everglades wetlands within the snail kite's range have received nutrient inputs higher than normal and at levels which require various governmental agencies to perform aquatic plant management. These attempts to control, reduce, and eliminate the spread of invasive and exotic plant species have also had negative effects on snail kites, as discussed below (see Human Disturbance).

Incompatible Water Management

The snail kite has experienced population fluctuations associated with hydrologic influences, both man-induced and natural (Sykes 1983a; Beissinger and Takekawa 1983; Beissinger 1986; Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008). Of particular concern are the water management strategies that have negatively affected snail kite nesting and foraging habitat in Lake Okeechobee and the WCAs and, as well as the Kissimmee Basin. Within Lake Okeechobee and WCA-3A, water management activities, in part, have rendered unsuitable large areas that were once productive breeding grounds. For example, the Clewiston Flats was the primary area within Lake Okeechobee which provided suitable nesting and foraging habitat for snail kites prior to 2006. However, that area becomes unusable by nesting snail kites at water stages below 15-feet NGVD (Cattau et al. 2009). The water stages in 2006 to 2009 were too low to allow successful nesting and foraging in the Clewiston Flats. Despite higher stages in 2010, the habitat within the Clewiston Flats did not support snail kite nesting or foraging as it became too thick to support sufficient numbers of apple snails; and still does not support snail kite nesting (Fletcher et al. 2014). In other portions of Lake Okeechobee's littoral zone, prolonged deep water caused vegetation changes resulting in loss of snail kite foraging habitat as well as decreasing growth and survival of woody plants that snail kites use for nesting and perching. Fortunately, relatively lower lake levels in later years, coupled with improvements to the aquatic vegetation and an increase in the exotic apple snail population, have allowed snail kites to nest in some areas of the lake (Moonshine Bay, Observation Island, Okeetantie, and Eagle Bay Marsh) since 2010.

Similar to effects seen on Lake Okeechobee, water management activities have increased water depths and hydroperiods in WCA-3A as well as some of the other WCAs, converting significant areas within these impoundments from wet prairie habitats to slough-type habitats. Vegetation changes have also occurred on lakes within the Kissimmee Basin, although deep water is not the culprit. Water regulation schedules designed to maximize flood control, and in some cases water supply, have greatly decreased the amount of intra-annual and inter-annual variation in lake stages. As a result, lake littoral zones have shrunk, as have the amounts of suitable snail kite habitat within them. Lack of extreme (high and low) water levels also contributes to the need for more frequent aquatic plant management activities, of both native and nonnative species, which can negatively affect kites as discussed below (see Human Disturbance). All of these vegetative changes represent a reduction in the quality of foraging habitat for snail kites, and a reduction in the suitability of habitat to support abundant apple snails. Managing for appropriate seasonal water levels in lakes and the WCAs is particularly important to maintain the balance of vegetative communities required to sustain snail kites. Restoration of habitat, including the management of appropriate water levels within the WCAs and Lake Okeechobee, as suggested by several researchers, is the key to successful recovery of the snail kite as it is predicated on their ability to successfully nest in these areas.

In addition to habitat effects, hydrologic conditions, and thus water management actions, may also adversely affect snail kite nest success, productivity, and juvenile survival both directly (*e.g.*, increased predation) and indirectly (*e.g.*, decreased foraging opportunities). Rapid recession rates during the dry (breeding) season and associated low water levels can allow nests to become accessible to land-based predators (discussed below), resulting in decreased nest success (Beissinger 1986; Sykes 1987b). The potential for this effect is higher for kites nesting near land (*i.e.*, in lakes or reservoirs) compared than those nesting in expansive marsh systems such as WCA-3A. Extremely low water levels and rapid recession rates can also limit foraging opportunities for nesting adults and juvenile snail kites, both of which require a sufficient forage base in the vicinity of the nest (Mooij et al. 2002). A decrease in the amount of suitable foraging habitat (snail availability) within the vicinity of a nest can lead to increased nest failures (due to nest abandonment by adults), decreased productivity (*i.e.*, less young fledged), and decreased juvenile survival and recruitment. Apple snail abundance has also been definitively linked to water regimes (Kushlan 1975; Sykes 1979, 1983a; Darby et al. 2005). Water levels which are too high or too low during the snail breeding season can delay, curtail, or entirely preclude egg cluster production in a given year, thereby resulting in decreased snail abundance and density in the following year(s). In addition, dry season reversals or very rapid wet season ascension rates can curtail egg cluster production and potentially kill native apple snail eggs if they become submerged. If reversals or ascension rates are large, they can also flood snail kite nests, causing nests to fail or nestlings to die. Impacts of water management operations and related water levels specifically within WCA-3A are discussed in more detail in the Environmental Baseline section of this Biological Opinion.

Nest Predation

Nest predation is another threat to snail kites. In 2010 and 2011, Olbert (2013) used cameras to monitor nests on Lake Toho. She found predation to be the primary cause of nesting failure, with almost no instances of nest collapse. Over the course of the study, she recorded a total of 32 predation events (57 eggs or young) where there was either a partial or complete loss of nest contents. The observed predator community included yellow rat snakes (*Elaphe obsoleta quadrivittata*), marsh rice rats (*Oryzomys palustris*), raccoons (*Procyon lotor*), American alligators (*Alligator mississippiensis*), a great horned owl (*Bubo virginianus*), fish crow (*Corvus ossifragus*), and a purple gallinule (*Porphyrio martinica*). Yellow rat snakes were the most common predator to consume both eggs and young (Olbert 2013). Fletcher et al. (2015) reported a snail kite nestling predation by a bald eagle (*Haliaeetus leucocephalus*) in WCA-3A.

According to Olbert (2013), raccoons were observed accessing nests in shallower water (approximately 18.79 ± 14.7 cm deep). The likelihood of predation by yellow rat snakes was not affected by water depth beneath the nest, but did increase for nests closer to shore (average distance of 4.15 m) compared to nests sites farther away (average 32.78 m). Alternatively, marsh rice rats were found to be present in nests farther from shore (average distance of

115.08m) but were absent from nest sites closer (approximately 16.01 m) to shore. Out of the 30 predation events where the predator was successfully recorded, seven events (23 percent) occurred diurnally and 23 events (77 percent) were nocturnal (Olbert 2013). Other sources of nest failure resulted from abandonment of eggs (n=10), unhatched eggs (n=3), accidental egg or young loss (n=2), and nest collapse (n=1) (Olbert 2013).

Invasive Non-native Species

Exotic snails can directly impact kite demography by facilitating or hindering energy acquisition, while indirect impacts derive from effects on kite behavioral decisions including movement, habitat use, and the timing of reproduction. Fletcher et al. (2015) found that snail kite breeding distribution closely tracked the spread of *Pomacea maculata* over the last decade. They did not find evidence that the exotic snail has direct negative effects on snail kite vital rates, but instead found a positive association with kite breeding rates, breeding season length, number of young fledged per successful nest, and juvenile apparent survival. They found no direct effects of *P. maculata* on adult apparent survival, but suggest that indirect negative effects may exist associated with altered spatial dynamics as it relates to geographically varied adult survival (*i.e.*, more kites breeding in the northern half of their range where adult survival is lower). This could partially offset the direct positive effects on snail kite recruitment, which likely result from increased prey density and availability in wetlands with *P. maculata* (Fletcher et al. 2015). Nonetheless, their modeling indicates that the cumulative impacts of the exotic snail have resulted in a small positive population growth, and "…that the exotic snail invasion has (overall) likely helped to lower short-term extinction risk for the snail kite, particularly in light of recent habitat degradations elsewhere in their range" (Fletcher et al. 2015). However, long-term effects of exotic snails on kite habitat and kite health are unknown. *P. maculata* has been known to profoundly alter the structure, function and composition of wetland ecosystems (Horgan et al. 2012; Monette 2014). In addition, exotic snails may serve as intermediate hosts of parasites and as vectors for diseases such as Avian Vacuolar Myelinopathy (AVM) as discussed below (see Disease) (Wilde and Netherland 2015). Although more investigation is needed, the presence of large numbers of exotic snails could also produce an evolutionary trap, if snail kites are attracted to areas subject to elevated rates of disturbance, predation, or other risks (Fletcher et al. 2015). Due to the amount of uncertainty related to potential future impacts of exotic snail populations on snail kite survival and recovery, growing and sustaining populations of the Florida apple snail remain important considerations when developing management strategies for, and addressing potential impacts to, the snail kite.

Disease

AVM is a neurological disease that comes from direct or indirect consumption of neurotoxins produced by blue-green algae (cyanobacteria) that can grow on the leaves of submersed plants, especially hydrilla. When herbivores consume hydrilla while the cyanobacteria and the neurotoxin are present, they can display loss of muscle control resulting in difficulty flying or swimming, and eventual death. AVM has been found to affect many species that consume infested hydrilla or that prey on species which do. Apple snails can accumulate the toxin, though not all show clinical signs of the disease (Wilde and Netherland 2015). Feeding trials have verified that the exotic apple snails can accumulate the toxin from hydrilla and pass AVM to their predators (chickens in the feeding trial).

Several studies on the KCOL have confirmed that at least some portions of hydrilla populations in lakes East Toho, Toho, Cypress, Hatchineha, and Kissimmee have the cyanobacteria present. These studies have also verified through a feeding trial (using chickens) that hydrilla collected from Lake Toho can pass AVM to consumers (Wilde and Netherland 2015). A smaller, follow-up study found that feeding exotic apple snails collected directly from Lake Toho to chickens did produce some signs of AVM (2 of 3 birds had mild brain lesions upon necropsy), but none of the birds showed any clinical signs of the disease (Wilde and Netherland 2015). Further, biologists collected coots from Lake Toho that they suspected may be showing clinical signs of AVM (slower flying, erratic flight, inability or reluctance to fly, etc) and necropsies confirmed several had mild AVM lesions (5 of 22 birds). To date, no sightings of eagles or snail kites displaying signs of AVM have been reported.

Contaminants

Additional potential threats to snail kites include exposure to bioaccumulated contaminants in their prey. Copper, used in fungicide applications and commonly found in disturbed areas of Everglades wetlands such as former agricultural lands, has been shown to bioaccumulate in apple snails and may lead to birth defects in snail kite nestlings (Frakes et al. 2008). Uptake of copper through sediments and diet has been demonstrated, with uptake from the latter being the primary exposure route for the Florida apple snail (Frakes et al. 2008; Hoang et al. 2008a). The ability of Florida apple snails to bioaccumulate copper has implications for the successful survival and recruitment of the Florida apple snail and its predator, the snail kite, at STAs and water reservoirs created for Everglades restoration projects; however, there is still uncertainty regarding the amount of copper that is actually bioavailable to snail kites. Additional information on Florida apple snail bioaccumulation of copper, copper bioavailability, and average exposure patterns of snail kites under various environmental conditions may be necessary to identify appropriate risk management scenarios for Everglades restoration projects.

Preliminary research has also been conducted to investigate potential effects of mercury on snail kites. Fletcher et al. (2015) evaluated mercury levels of snail kite nestlings (obtained from feathers collected in 2013 across the breeding range) to examine potential effects at the individual level (nestling size, juvenile survival), nest level (number of eggs, nestlings, and fledglings per successful nest), and site level (daily nest survival, number of fledglings per successful nest). Their analyses did not find significant correlations between nestling mercury levels and snail kite vital rates, although mercury concentration had a negative (but non-significant) effect on monthly juvenile apparent survival (Fletcher et al. 2015). However, they recognize that some potential effects of mercury could limit reproductive success prior to fledging (*e.g.*, egg viability), and that additional research is needed in this area including investigation into the relationship between adult/parent mercury levels and reproductive metrics (Fletcher et al. 2015).

Human Disturbance

Snail kites can be negatively impacted by a variety of human activities including habitat management activities (*e.g.*, aquatic plant maintenance, prescribed burning) and recreational activities (*e.g.*, boating, fishing, hunting, wildlife viewing). The Service works cooperatively with many agencies, organizations, and entities to avoid negative impacts to snail kites associated with these types of activities. Rodgers et al. (2001) described a program to reduce impacts of aquatic plant management on snail kites. They found that the actions of several agencies in controlling aquatic plants have caused nest collapse, particularly in herbaceous vegetation such as cattail and bulrush. They state that these impacts in Lake Okeechobee and the KCOL were reduced through cooperation and improved communication between agencies. In addition to the potential collapse of nests, the Service is concerned about any excessive application of herbicides, because this would reduce available habitat for apple snails. The Service has expanded on these coordination efforts by notifying aquatic plant management groups during the snail kite nesting season of the location of active snail kite nests (Service 2006c) to assist them in avoiding effects, and by proactively coordinating throughout the year to optimize aquatic plant management to benefit, or at least avoid negative impacts to, kite nesting and foraging areas.

Environmental Stochasticity

Natural variation in weather patterns and inclement weather may also affect snail kite nesting success and survival. Wind storms can cause toppling of nests, particularly on Lake Okeechobee and Lake Kissimmee due to the long wind fetch across these large lakes. Heavy rain can cause mortality of young through exposure, decreased foraging ability of tending adults, or nest collapse. Cold weather can halt or delay nest-building and courtship as well as cause nest failure, either through decreased availability of apple snails or mortality of young snail kites due to exposure. Abandonment of nests before egg-laying is also common, particularly during drought or following passage of a cold front.

4.1.8. Summary of Species Status

The overall snail kite population exhibited steep declines from 1999 to 2002 and from 2006 to 2008, but rebounded slightly starting in 2010. In 2014, the population estimate was significantly higher (1,754 birds). On average, adult snail kites have relatively high annual survival rates although it is probably reduced in drought years. Snail kites are considered nomadic; following fledging, adults may remain around the nest for several weeks, but once young are fully independent adults may depart the area. Outside of the breeding season, snail kites regularly travel long distances within and among wetland systems in southern Florida. The observed variability in juvenile survival is related to variation in environmental conditions, including those hydrologic conditions that directly affect the survival and productivity of the apple snail.

Additionally, these hydrologic conditions have significant effects on snail kite nest success. Marshes and lake littoral zones with patches of herbaceous emergent wetland plants and open water generally provide the best snail kite foraging habitat. Native and exotic apple snails are critical because they comprise the great majority of the snail kites' diet. Apple snail survival and recruitment can be impacted by dry conditions. Optimal water depths should range between 4 and 20 inches during the peak native apple snail breeding period (April and June). Snail kite nesting primarily occurs between January and June with peak nest initiation from February to April. The clutch size ranges from one to five eggs, with a mode of three. Nesting almost always occurs over water, which may deter predation. Nests constructed in herbaceous vegetation are more vulnerable to collapse due to the weight of the nests, wind, waves, and boat wakes and are more exposed to disturbance by humans.

The principal threat to the snail kite is the loss, fragmentation, and degradation of wetlands. Hydrologic conditions, both natural and unnatural (*i.e.,* water management), may also adversely affect snail kite nest success and juvenile survival both directly (*e.g.,* increased predation) and indirectly (*e.g.,* decreased foraging opportunities). Rapid recession rates during the dry (breeding) season and associated low water levels can allow nests to become accessible to land-based predators, resulting in decreased nest success. The abundance of apple snails is also linked to water regimes. Extremely low water levels and rapid recession rates can limit foraging opportunities for juvenile and nesting adult snail kites, both of which require a sufficient forage base in the vicinity of the nest.

4.2. ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Everglade snail kite within the Action Area.

4.2.1. Status of the Species within the Action Area

The information in the Status of the Species section also addresses the status of the species within the action area, and is incorporated here by reference. The following discussion provides supplemental information specific to WCA-3A.

After serving as a stronghold for snail kite breeding for several decades, reproductive effort and productivity in WCA-3A dropped sharply after 1998 (Table 21). The number of young known to have fledged from the area over the last 15 years (162 fledglings) is less than the number of young fledged in WCA-3A during 1998 alone (176 fledglings) and only about half of the number fledged in 1997 alone (303 fledglings). No young were reported as fledged from WCA-3A during 2001, 2005, 2007, 2008, 2010, or 2012, and only two young (from one nest) successfully fledged in 2009. More recently, nesting effort and productivity have slightly increased in WCA-3A, with 36 active nests in both 2013 and 2014, and 14 and 30 fledglings in these years, respectively. Preliminary data for the 2015 nesting season indicate decreased nesting effort, but nest success appears to have been high.

While short-term drops in kite nesting can be attributed to drought conditions in a given year, it is believed that the longer-term decrease in kite nesting in WCA-3A is due to previous and concurrent decreases in apple snail populations and habitat quality and quantity in this area. Although high apple snail densities (*e.g.*, > 1.0 snail per m2) were found in WCA-3A in 2002 and 2003, this was followed by lower egg cluster production in the spring of 2003 and a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004 (Darby et al. 2005). Relatively low densities (0.02 to 0.40 snails per m2) continued at sampled sites into 2005 to 2007 and again at a subset of these sites in 2010 (0.06 to 0.08 snails per m2). Sampling in WCA-3A in 2010-2012 by Wight et al. (2013) also found slightly higher but still relatively low densities of native apple snails, suggesting that these populations had not recovered since their decline in 2004 (Figure 23). Snail densities in southern WCA-3A in 2010-2012 were 5 to 10 times lower than densities observed in 2002-2003 (Wight et al. 2013). Observed egg cluster densities and per capita egg cluster (PCE) estimates were also relatively low in 2010-2012, indicating that the reproductive rate and recruitment into the apple snail population was relatively low (Wight et al. 2013). Subsequent annual sampling has found higher apple snail densities at some sites within kite foraging polygons in southwestern WCA-3A. In 2014, native apple snail densities ranged from 0.16 to 0.94 snails per m2 in eight sites supporting foraging kites (Therrien and Darby 2014). However, in this same year, zero native apple snails were found at seven of eight random sites. In 2015, preliminary native apple snail densities ranged from 0.30 to 0.70 snails per m2 in four sites supporting foraging kites (Therrien and Darby 2015). In 2 "poor kite foraging sites" (kites observed foraging but not capturing snails) and 14 of 16 random sites, zero native apple snails were found (Therrien and Darby 2015). Observed native apple snail egg cluster densities continue to be relatively low in nearly all sites.

The somewhat higher densities of native apple snails found in areas supporting foraging kites in southwestern WCA-3A during 2014 and 2015 is promising, but continued low (to zero) densities throughout the rest of the water conservation area indicate that native apple snail populations have not begun to recover from the 2004 population crash. Continued low densities have caused researchers to question whether an Allee effect is, at least in part, to blame (Wight et al. 2013; Pomacea Project 2013). This can occur when population densities decline to such low levels that scattered individuals have trouble finding mates. Thus, low snail populations resulting in low egg cluster production in addition to high predation rates may explain the continued low snail densities in WCA-3A (Wight et al. 2013).

Foraging kites in southwestern WCA-3A are also utilizing exotic snails, and the increase in exotic snail populations in this area have likely been a contributing factor to the increase in kite nesting in this area in recent years. *Pomacea maculata* was first found in samples at several sites in southwestern WCA-3A during 2011, and subsequent monitoring has indicated the exotic snail is still concentrated in this area (near SR 41), radiating from the 40-mile bend boat ramp and, beginning in 2015, starting to spread further east (Wight et al. 2013; Therrien and Darby 2015). The percentage of exotic snails found in throw traps has continued to increase since 2011, and exotic snails have been found in all kite-foraging sites in recent years. Observations by Darby (2015) indicate that kites are foraging in proportion to what is available (native versus exotic snails).

Apple snails are found in varied wetland habitats in WCA-3A, although densities tend to be higher in sparse prairies and emergent sloughs, compared with much lower densities (often by a factor of two to three) in *Nymphaea odorata*-dominated sloughs (Karunaratne et al. 2006). Within wet prairie habitats, Karunaratne et al. (2006) found greater snail densities in P*anicum* *hemitomon* as compared to *Eleocharis cellulosa*. Significantly fewer snails were found in dense *E. cellulosa* as compared to habitats with lower stem density. Wight et al. (2013) found that apple snail egg cluster density was significantly greater along the *Cladium jamaicense* (sawgrass) ecotone than in wet prairie habitat, which was consistent with previous studies (Turner 1996; Darby et al. 1999), and that egg cluster densities were greatest along the western sawgrass ecotone. However, their results also indicated that egg cluster production in wet prairie habitat contributed to over 50 percent of total egg cluster production in most sites (although, in 4 of 11 sites, there was zero egg cluster production in wet prairie) (Wight et al. 2013). This new information suggests that wet prairie habitat contributes more significantly to egg production than had been described in the past (Wight et al. 2013). Wight et al. (2013) concluded that habitat containing a sawgrass ecotone and transitional wet prairie habitat (for egg cluster production), as well as deeper water slough habitats (which may provide refugia for some snails during a drying event) would provide the greatest variety of habitats to support local apple snail populations.

Previous studies in this region (Wood and Tanner 1990; David 1996) indirectly documented the conversion of wet prairies to aquatic sloughs, which constitutes a loss of quality snail kite foraging habitat (Kitchens et al. 2002). None of these studies were designed to provide inference beyond the isolated sites in which they were conducted, and unfortunately occurred largely outside kite foraging and nesting areas. Because of the concern that conversion of wet prairie/emergent slough habitats to deeper, less desirable sloughs will lower kite reproduction, primarily through lower prey base availability in those communities, Dr. Christa Zweig and other researchers initiated a study in 2002 to monitor critical kite breeding and foraging habitat in WCA-3A. Three communities (as described by cluster/indicator species analysis; Fletcher et al. 2014) important to kite foraging in southern WCA-3A are *E. cellulosa*, *E. cellulosa*/sawgrass prairie, and *Bacopa caroliniana* transitional. During the period of study by Zweig, the *E. cellulosa* community only occurred in the western side of the study area (WCA-3A south of Interstate 75 and west of the Miami Canal) and had disappeared from four out of five plots under continuous sampling from 2009 to 2011 (Fletcher et al. 2015). Further analyses suggest a continuing decreasing trend for *E. cellulosa* communities in WCA-3A from 2010-2013, indicating further declines of foraging habitat for snail kites in this area (Fletcher et al. 2014). The *E. cellulosa*/sawgrass community has appeared intermittently across the landscape, but dominantly in southwestern WCA-3A. It is currently only present in one plot in the southwest quadrant (Fletcher et al. 2015). The Bacopa transitional community also only occurs in the western portion of the study area and has been stable in two of the continuous sampling plots (Fletcher et al. 2015). Between 2012 and 2013, it appeared in four other plots, one in the southwest and three in the northwest of the study area. Continued significant increases in the *N. odorata* community and decreases in *E. elongata* community were also observed, although there was a small decrease in *N. odorata* in 2011 due to dry conditions (Fletcher et al. 2014). Stem density of *N. odorata* increased significantly over time, while stem density of all emergents decreased significantly over time (Fletcher et al. 2015). These data suggest further degradation of snail kite foraging habitat has occurred over the last decade, although the extent has not yet been quantified across WCA-3A.

4.2.2. Factors Affecting the Species Environment within the Action Area

The persistence of the snail kite in Florida depends upon maintaining hydrologic conditions that support the specific vegetative communities that compose their habitat along with sufficient apple snail availability across their range each year (Martin et al. 2008). Operation of the C&SF Project and other hydrologic management actions has a significant effect on hydrologic conditions within most of the areas occupied by snail kites. Within the Action Area, the Corps and District manage water levels in snail kite habitat in accord with many different local and regional water management plans and schedules. The Service has conducted formal consultation on the MWD and C-111 Projects, IOP, ERTP, the Lake Okeechobee Regulation Schedule, and many other projects that have affected snail kites and their habitat. Water management plans affect water levels in marshes and lakes upon which snail kites rely, the rates of water level recessions in lakes and marshes, and the timing of high and low water events. These factors, in turn, directly affect snail kite habitat suitability.

In the unaltered Everglades ecosystem, snail kites were able to cope with extreme and varying hydrologic conditions during a given year or at a given location due to their nomadic behavior and the network of suitable habitats that existed within the Everglades and throughout the rest of the kite's range in Florida. These extremes, when experienced at a natural frequency, are essential to maintaining suitable nesting and foraging habitat for the snail kite and its prey, and the natural variability within the system resulted in a habitat mosaic which ensured long-term persistence of suitable habitat for Everglades wildlife, including kites and apple snails.

The compartmentalization of Everglades' wetlands under the C&SF Project, and subsequent hydrologic management of each of the compartments, has reduced the connectivity of wetland systems upon which kites rely and has changed the timing, duration, and frequency of high and low water conditions within wetlands. Separate and independent management regimes for the different compartments have also impacted snail kites, in some cases by allowing unfavorable conditions in adjacent wetland units at the same time. Both short-term natural disturbances (*e.g.*, drought) and long-term habitat degradation, including impacts to their prey base, limit the snail kite's reproductive ability. WCA-3A has been identified as the most critical component of snail kite habitat in Florida, in terms of its influence on demography (Mooij et al. 2002; Martin 2007; Martin et al. 2007). A concern is the lack of or decreased reproduction within this area since the late 1990s. Current water regulation schedules shorten the window of time during which kites can breed, and rapid recession rates often result in nest abandonment (Cattau et al. 2008). Hydrologic conditions within WCA-3A have also resulted in reduced apple snail productivity, abundance, and density. Researchers have also identified that high water during the breeding season can have significant negative impacts to apple snail egg cluster production (Darby et al. 2005; Darby et al. 2009). In addition, higher-water levels and longer hydroperiods have been implicated in the conversion of wet prairies (prime kite foraging habitat) to sloughs within WCA-3A beginning around 2001 (Zweig 2008; Zweig and Kitchens 2014). The current WCA-3A Regulation Schedule does not mimic the seasonal patterns driven by the natural hydrological cycle, resulting in water depths in southern WCA-3A that are too deep from September through January and sometimes into the spring (Cattau et al. 2008). The subsequent rapid drop in water level recession rates from the elevated stage schedule to the dry season low decreases foraging opportunities around individual nests and locally within wetland units, negatively affecting nesting adult kites and their young and resulting in decreased nest success, juvenile survival, and recruitment (Cattau et al. 2008).

Under the current WCA-3A Water Regulation Schedule, there are three primary factors which have the potential to adversely affect snail kites: (1) prolonged high water levels during September through January (or beyond in some years); (2) prolonged low water levels during the early spring and summer; and (3) rapid recession rates during the breeding season. Each is discussed in detail below.

4.2.2.1. ***Prolonged High Water Levels***

During most years, water levels naturally peak late in the wet season (*i.e.*, September-October) and begin receding shortly thereafter. Water management in WCA-3A has resulted in high water levels that extend into the beginning of the dry season – often early January and sometimes beyond. This can result in decreased snail kite nest success and juvenile survival, decreased apple snail productivity and availability, and, if frequent, degradation of nesting and foraging habitat.

Prolonged high water extending into January is associated with decreased snail kite nest success and juvenile kite survival (Cattau et al. 2008). From as early as late November into the spring, snail kite courtship and pair formation activities, including nest site selection and construction, are occurring. High water conditions during this time can act as an ecological trap in which kites build nests at higher Ground Surface Elevations (GSEs) and are then left “high and dry” when water level recedes (Sykes et al. 1995; Cattau et al. 2008). It is believed that snail kites choose nest sites based on water depths directly underneath the nest and in the immediate vicinity. Appropriate water depths in these areas are important to deter predation and provide sustained foraging opportunities for nesting adults and their young. If water levels change rapidly during the nesting season – for instance, due to water management operations conducted in order to meet the target water regulation schedule by alleviating high water conditions that extended into the dry season – nesting adult kites and juveniles fledged from these nests may suffer from reduced foraging opportunities, especially when low water levels cause snails to stop moving and become unavailable to foraging kites, resulting in both decreased nest success and lower juvenile survival rates.

High water during the breeding season also adversely affects apple snail productivity, and by extension snail density. Apple snail studies have documented a dramatic increase in spring egg cluster production as water depths fall below approximately 1.3 to 2.0 ft (40 to 60 cm) in WCA-3A and other wetlands (Darby et al. 2005). Darby et al. (2005) found high snail densities (*e.g.*, > 1.0 snail per m2) in WCA-3A in 2002 and 2003, where densities reflected 2 years (2001 and 2002) of relatively low water levels. In contrast, water depths in 2003 remained above 1.3 to 2.0 ft during the peak reproductive season, and they observed a delay in the peak of egg laying and a decline in annual per capita egg production and egg cluster counts (*e.g.*, approximately 130 egg clusters per 50-meter transect in an area with > 1.0 snail per m2; Darby et al. 2008). This decrease in 2003 spring egg cluster production resulted in a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004. As discussed above, snail densities have yet to rebound after this drastic decline. High water during the breeding season also significantly affected the proportion of juvenile snails – specifically, the deeper the water in the previous year, the greater the proportion of small (< 20 mm) snails found in March and April (Darby et al. 2009). This may result from (1) a shift in egg production from summer to fall months, with snails still not of adult size as winter approaches, and (2) suppressed snail growth in deeper water, although the mechanism behind this has not been studied (Darby et al. 2005, Darby et al. 2009). Since kites typically select snails > 20 mm for foraging (Sykes et al. 1995), a high percentage of apple snails with shells < 20 mm in March and April may not support the energetic needs of nesting kites, resulting in fewer nest initiations and more nest failures (Darby et al. 2009).

To isolate the effect of water depth on apple snail egg production, Therrien and Darby (2015) conducted a mesocosm study in March-June 2015, utilizing 26 mesocosms in southeastern and southwestern WCA-3A, and compared the number of egg clusters between mesocosms located in shallow (30-49 cm), middle (50-80 cm), and deep (90-100 cm) water depths. Their results indicate that egg production was approximately four times greater in shallow versus deep water depths across all months (Darby 2015). Preliminary analyses suggest that depth alone explains approximately 50 percent of variation in mesocosm egg production, with the remaining variation probably explained by nutrients, behavior (*e.g.*, movement), and the presence of parasites (Darby 2015). Observations by Darby (2015), both during field surveys and the mesocosm study, indicate that the highest egg production consistently occurs at water depths between 20 to 50 cm.

High water levels and extended hydroperiods have resulted in vegetation shifts within WCA-3A, degrading snail kite habitat. The extended deep water conditions from September into January or beyond, whether resulting from weather conditions, water management operations, or a combination of both, appear to have reduced the amount of woody vegetation in the area and contributed to the transition of wet prairies to open water sloughs (Zweig 2008; Zweig and Kitchens 2008). These habitat conversions directly affect snail kites in several ways, most importantly by reducing the amount of suitable nesting and foraging habitat, and reducing prey abundance and availability. Woody vegetation, such as pond apple, willow, and cypress which are used by kites for nesting and perch hunting, can be killed or severely stressed by extreme high water conditions and extended hydroperiods. Such vegetation is slightly elevated above the surrounding marsh and so is affected by prolonged higher-than-normal water levels.

Within WCA-3A and the Greater Everglades, wet prairie exists as a component of the ridge and slough landscape, occurring in the transition zone between higher sawgrass ridges and deeper lily-dominated sloughs. Wet prairies serve as the prime habitat for apple snail egg production and snail kite foraging, which species experts believe is currently the limiting factor to snail kite productivity in WCA-3A (Darby 2008; Kitchens 2008). In addition to deeper water conditions, hydroperiods in WCA-3A have increased, lengthening the time between drying events and further contributing to the conversion of wet prairie. Prolonged hydroperiods reduce habitat structure in the form of emergent vegetation, which is critical for apple snail aerial respiration and egg deposition (Turner 1996; Darby et al. 1999). Occasional drying events are essential to maintain healthy wet prairie and the mosaic of vegetation types that exist in the Everglades system (Sklar et al. 2002; Karunaratne et al. 2006; Darby et al. 2008). However, little annual variation in low water depths has occurred within WCA-3A since 1993, virtually eliminating these essential drying events. The effects of this are particularly apparent in southwestern WCA-3A, which has experienced excessive ponding in recent years, as the observed habitat community changes discussed above illustrate.

The transition of wet prairies to open water sloughs also affects prey availability for snail kites. Snails tend to avoid areas where water depths are greater than 50 cm (Darby et al. 2002). Avoidance of deeper depths may be related to the type and density of vegetation in deeper water areas, food availability, or energy requirements for aerial respiration (van der Walk et al. 1994; Turner 1996; Darby 1998; Darby et al. 2002). Water-lily sloughs support lower snail densities as compared with wet prairies (Karunaratne et al. 2006). Limited food quality and lack of emergent vegetation in the sloughs may account for the lower snail densities. Research indicates that snails depend upon periphyton for food (Rich 1990; Browder et al. 1994; Sharfstein and Steinman 2001), which may be limited within deeper water environments. Karunaratne et al. (2006) observed little or no submerged macrophytes and epiphytic periphyton in the sloughs they studied in WCA-3A. In contrast, species commonly encountered within wet prairie habitat (*e.g.*, Eleocharis spp., Rhynchospora tracyi, Sagittaria spp.) support abundant populations of epiphytic periphyton (Wetzel 1983; Browder et al. 1994; Karunaratne et al. 2006). Apple snails also depend upon emergent vegetation for aerial respiration and oviposition. A reduction in the number of available emergent stems for egg deposition would also contribute to the observed lower snail densities within sloughs.

4.2.2.2. *Prolonged Low Water Levels*

Low water levels have a significant effect on snail kite nest success in WCA-3A. If water levels become too low and food resources become too scarce, adults will abandon their nest sites and young (Sykes et al. 1995). Nest success analyses performed by Cattau et al. (2008) suggest that decreasing values of the annual minimum stage (*MIN*) has a significant negative effect on nest success. During the years used in their analysis, *MIN* in WCA-3A ranged from 8.51 to 9.43 ft NGVD. Within this range, observed nest success was highest (approximately 60 percent) at a stage of 9.3 ft NGVD. The highest minimum level (9.43 ft NGVD) occurred in a year with observed nest success equal to approximately 40 percent. In the regression analysis, this data point fell outside (below) the 95 percent confidence interval. This illustrates the observation of Cattau et al. (2008) that, while values of *MIN* on the lower end of the scale have a predictable negative effect on nest success, high values of *MIN* do not guarantee high nest success. Based on the regression analysis, an annual minimum stage of 8.8 ft NGVD is associated with nest success of approximately 35 percent. Nest success observed in the 2 years (1999, 2000) with this approximate MIN value was calculated to be approximately 18 percent and 30 percent, respectively – below the regression line. However, during years with approximate MIN values near 8.5 ft NGVD (2002, 2004, 2006), observed nest success ranged from approximately 20 to 45 percent. The highest of these was observed in the year with the lowest stage (2004, 8.51 ft NGVD), and this data point fell outside (above) the regression line.

A strong relationship also exists between juvenile kite survival rate and annual minimum stage (Martin et al. 2007; Cattau et al. 2008). Due to their inability to move large distances, juvenile snail kites rely upon the marshes surrounding their nests for foraging. If water levels within these marshes become too low to support foraging (due to decreased apple snail availability), juvenile survival will be diminished. Survival analyses performed by Cattau et al. (2008) indicate that decreasing values of *MIN* also had a significant negative effect on juvenile kite survival. During the years used in the analyses, *MIN* in WCA-3A ranged from 8.51 to 9.70 ft NGVD. Within this range, model-averaged estimated juvenile survival was highest (approximately 54 percent) at a minimum stage of 9.07 ft NGVD (Cattau et al. 2008). With the exception of the 2003 estimate, the data suggest that juvenile survival levels off near 50 percent at minimum water levels ≥ 9.0 ft NGVD. With the exception of the 2000 estimate (associated with a severe region-wide drought which also greatly affected adult kite survival), juvenile survival remained ≥ 40 percent at minimum water levels ≥ 8.8 ft NGVD. In terms of water depths (as opposed stage), estimated juvenile kite survival rates for years when water levels fell below 10 cm was substantially lower compared to years where estimated water depths stayed above 10 cm (Cattau et al. 2008).

While high water during the breeding season can result in delayed and decreased snail productivity, low water levels can also negatively affect snail egg cluster production, recruitment, and survival. Apple snail egg production is maximized when dry season low water levels are less than 40 cm but greater than 10 cm (Darby et al. 2002). Once water levels drop below approximately 0.33 ft (10 cm), snails stop moving (and reproducing), remaining stranded near the ground surface until water levels rise again (Darby et al. 2002; Darby et al. 2008). Thus, water levels below 0.33 ft will negatively affect snail egg cluster production. Depending upon the timing and duration of such low water conditions, apple snail recruitment can be significantly affected by the truncation of annual egg production and stranding of juveniles (Darby et al. 2008). Since apple snails have a 1.0 to 1.5-year life span (Hanning 1979; Ferrer et al. 1990; Darby et al. 2008), they only have one opportunity (*i.e.*, one dry season) for successful reproduction. Egg cluster production may occur from February to November (Odum 1957; Hanning 1979; Darby et al. 1999); however, approximately 77 percent of all apple snail egg cluster production occurs during April through June (Darby et al. 2008). Water levels < 10 cm during peak apple snail egg cluster production substantially reduce annual per capita egg production, and thus recruitment and apple snail densities (Darby et al. 2008). If possible, dry downs during this critical time frame should be avoided. The length of the dry down, and age and size of the snail, are all important factors in determining apple snail survival. Larger apple snails can survive dry downs better than smaller apple snails (Kushlan 1975; Darby et al. 2006, 2008). Darby et al. (2008) found that 94 percent of pre-reproductive adult-sized snails survived dry down conditions lasting 6 weeks, 71 percent survived after 12 weeks, and 27 percent survived after 18 weeks. Smaller snails exhibited significantly lower survival rates – approximately 50 percent after only 8 weeks dry (Darby et al. 2008). Snails in dry wetlands may experience significantly lower survival in the presence of substrate-probing predators.

However, short-term (same year) impacts can be balanced by longer-term improvements to apple snail habitat. Periodic dry downs promote maintenance of wet prairie habitat, as discussed below, and regeneration of emergent vegetation critical for snail oviposition and aerial respiration (Karunaratne et al. 2006). Periodic drying events may also result in a decrease in predation pressure on juvenile snails, thereby increasing recruitment and allowing a greater proportion of the annual snail cohort to reach adult size (Darby et al. 2009). When attempting to minimize dry down-associated impacts to apple snails, timing is as important as duration, and the two are often intertwined (*i.e.*, dry downs occurring earlier in the spring will typically be longer in duration). The longer the drying event overlaps with peak egg cluster production, the greater the impact on the population (Darby et al. 2008).

Wet prairie vegetation needs occasional dry downs (water depths < 0.13 ft [4 cm], depending on vegetation species) for regeneration, and it has long been recognized that water levels should recede below ground periodically to maintain healthy wet prairie habitat, although moist soil conditions are needed for seed germination and establishment of new seedlings (Dineen 1974; Goodrick 1974; Zaffke 1983). Analyses conducted by Richards et al. (2009) defined a spikerush community occurring across the Everglades landscape which was dominated by *E. cellulosa* and contained P. hemitomon. This community contained an average dry season depth of 0.13±0.10 ft (4±3 cm) with a hydroperiod of 327±7 days. Ross et al. (2006) described a similar spikerush community in northern and central Shark Slough, ENP which exhibited a hydroperiod of 344 days. These results suggest a dry down duration of approximately 3 to 6 weeks. Frequency can be inferred from research on community composition and transition between communities in WCA-3A conducted by Zweig and Kitchens (2008). Based on their analyses of hydrological and vegetation data (sampling initiated in 2002), Zweig and Kitchens (2008) found evidence of wet prairie converting to deeper, less desirable habitats for snail kites (*e.g.*, sloughs) in as little as 4 years. Their results also suggested that such effects on community composition were highly correlated with recent (within 2 years) and historic (within 4 years) minimum and mean water levels during the dry season. These results suggest a minimum frequency for dry down conditions of approximately once every 4 years. Dry downs that occur more frequently, or for longer periods of time, can result in proliferation of sawgrass.

4.2.2.3. *Rapid Recession Rates*

Under high water conditions early in the nesting season, kites tend to initiate nests in upslope, shallower sites. Also in these years, water regulation schedules can require water managers to initiate rapid recession rates in the spring to meet the target dry season low water level. Rapid recession rates can also be caused or exacerbated by high rates of evapotranspiration and low precipitation. Whatever the reason, rapid recession rates during the breeding season, and the resulting large amplitude (overall difference between high and low water levels), can result in decreased snail kite nest success and decreased juvenile kite survival. Breeding adults may not be able to raise their young before the water levels reach a critical low water depth, below which snail availability to kites is drastically reduced. In addition, when water levels recede below an active snail kite nest, predation risk increases due to nest exposure to terrestrial predators (Sykes et al. 1995). As a result, nesting success can be further reduced in these areas. Nest success analyses performed by Cattau et al. (2008) suggest that increasing recession rate (difference between stage on January 1 and the dry season minimum stage, divided by the number of days between these) had a significant negative effect on snail kite nest success. Of the eight single-variable models, recession rate had the strongest negative effect on nest success, with a beta parameter estimate almost 8 times greater than that of the annual minimum water level and more than 15 times greater than any other hydrological variable (Cattau et al. 2008). However, recession rate appears in only one of the top five multivariate models, suggesting that its effect on nest success may be buffered by other hydrological variables (*e.g.*, a high minimum water level) (Cattau et al. 2008). During the years used in their analyses, recession rate in WCA-3A ranged from approximately 0.04 to 0.14 ft per week in WCA-3A (Cattau et al. 2008). Based on the regression analysis, a recession rate of 0.05 ft per week was associated with a nest success slightly above 50 percent, and recession rates of 0.06-0.10 ft per week were associated with an approximate nest success of approximately 38 to 48 percent. Based on methodology used by Cattau et al. (2008), these recession rates can also be applied throughout the dry season to calculate related values of amplitude, where 0.05 ft per week translates to an amplitude of approximately 1.0 ft between January 1 and the dry season low (occurring, on average, around May 15). Their analysis also indicated a negative relationship between amplitude (between pre-breeding maximum and breeding season minimum water levels) and juvenile survival (Cattau et al. 2008).

Studies of apple snails suggest that receding water promotes egg cluster production (Hanning 1979; Turner 1996); yet rapidly decreasing water levels associated with fast recessions may cause egg clusters laid on emergent stems during higher water levels to fall into the water and die, while rapid increases in water level (*e.g.*, dry season reversals, typically associated with storm events) may drown egg clusters. Thus, a slow, gradual recession, similar to that specified for snail kites, is preferred (as opposed to having no recession, rapid recession, or reversal of water levels).

4.2.2.4. *Multi-Species Transition Strategy for WCA-3A*

In order to address the adverse effects to snail kites in WCA-3A discussed above, the Service along with Drs. Kitchens, Darby, and Zweig, and others, developed a series of water level recommendations for WCA-3A that addressed the needs of snail kites, apple snails, and vegetation characteristic of their habitat. These recommendations were then incorporated with those for additional at-risk species and habitats to develop a comprehensive strategy for water management in WCA-3A during the transition from current to "restored" conditions, using increased snail kite productivity as a success criterion. This water management strategy, the Multi-Species Transition Strategy for WCA-3A (MSTS), identified water stage and depth recommendations (based on the 3AVG) divided into 3 time periods representing: (1) the high peak-stage of the wet season (Sep 15 to Oct 15); (2) the pre-breeding season (January); and (3) the latter portion of the peak breeding season during which dry season water levels are typically lowest (May 1-31; hereafter referred to as the dry season low). Additionally, it identified recommended rates of change between high and low water levels between each of these time periods (*i.e.*, recession and ascension rates). Complete documentation of the MSTS, including its specific recommendations, discussions of the best available science used in its development, its intended implementation, and its limitations and recommendations for further refinement are provided in Appendix D of the 2010 ERTP BO.

By design, the MSTS does not attempt to incorporate extremely wet and extremely dry years which will naturally occur at some infrequent basis (*e.g.*, once every 10-20 years), during which attempts to meet minimum or maximum water levels or target recession rates may be impractical due to system constraints. In accordance with the intent of the MSTS, such events can be viewed as opportunities to incorporate natural stochasticity and inter-annual variability into the system. Such years will likely require additional coordination and may necessitate water management outside the MSTS, but can still work to the benefit of species.

The intent of the MSTS is to facilitate decision-making amongst multiple interests and to serve as a tool when evaluating potential water management actions within WCA-3A. It is important to note that the water stages and depths identified in the MSTS are not targets which should be managed for in isolation or without consideration of appropriate biological, hydrological, and meteorological information. To properly implement and apply the MSTS to achieve the desired benefits for species and habitats, regular and close coordination is necessary between water managers and biologists.

The recommendations in the MSTS have provided the Service and other agencies with the best professional judgment and best available scientific information for multi-species management within WCA-3A. As such, the MSTS formed the basis for many ERTP Performance Measures (PMs) and Ecological Targets (ETs) in the Corps' BAs (2010 and 2015) and were incorporated into the Service's ITS as well. Scientists from the U.S. Geological Survey, Everglades National Park, the Service, and other agencies and universities have recently begun collaboration to revise the MSTS through development of a preliminary decision-making framework that will use hydrologic forecasting combined with species/habitat-specific models to evaluate potential effects of hydrologic scenarios on species of concern. While we anticipate that this decision support tool will allow for comprehensive evaluations of water management and, ultimately, better-informed decisions to benefit the Everglades ecosystem, critical gaps (including development of a snail kite HSI) must be filled before the tool can be used. Therefore, our analysis of effects under the continuation of ERTP will utilize the recommendations under the current MSTS, updated with any new or revised information as applicable.

4.2.2.5. ***Water Quality***

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species into snail kite habitat, reducing the habitat suitability for nesting and foraging. Dense growth of these plants also has the potential to reduce the ability of snail kites to forage for apple snails. In addition, the effects of higher nutrient inputs on plant growth can necessitate habitat management activities in areas used by snail kites. These activities can have negative effects on nesting kites if not conducted appropriately.

4.2.2.6. *Climate Change*

Climate change represents significant short and long term threats to the environmental baseline of the kite and their habitat (Appendix D). Surface temperatures and evapotranspiration are expected to increase which will likely adversely increase recession rates during the snail kite breeding season and when native apple snail production is at its peak. Rainfall patterns are expected to change with more rain in the fall and winter months and less rain during the spring and summer months. Changes in rainfall patterns can create changes in vegetation and habitat.

The Service will continue to monitor this situation closely and will implement Strategic Habitat Conservation Planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006b).

4.2.2.7. *El Nino*

Wetter than average conditions due to the very strong El Nino effects prevailed in South Florida through the first half of 2016, encompassing the 2016 kite breeding season (Figure 18). These El Nino events have a significant effect on water levels and depths in the habitat. The occurrence of El Nino conditions resulted in a major short term negative effect on the environmental baseline for kite habitat in 2016 because of the wetter conditions. After the peak of El Nino, the first observation of kites in the WCA-3A was in January (13 total kites). Kites began active nesting at the beginning of March (observed during the completion of the 3rd survey), and by April there were a total of 9 active nest in the WCA-3A with the highest number of kites observed at 34. After the completion of survey 5 (May 6 – 8, 2016) there was only one kite observed within the 3A area, and all active nesting during that time had failed, indicating that there was no suitable habitat (foraging and nesting) for kites in the WCA-3A.

4.2.3. Summary of Baseline Conditions

From a high of 247 nests and 303 fledglings in 1997, snail kite nesting in WCA-3A has dropped drastically since. This long-term decrease is believed to be due to a similar crash in apple snail populations in WCA-3A and continued habitat degradation (primarily of foraging habitat). Over this same time span, the snail kite population in Florida decreased from approximately 3,000 birds in 1999 to a low of approximately 685 birds in 2008. While some of this steep decline was known to be caused by regional droughts, the population was also greatly impacted by the removal of WCA-3A (and Lake Okeechobee) as productive breeding grounds. Since 2010, the population has begun rebounding (estimated at 1,754 birds in 2014), in large part due to the high nesting effort and productivity in the Kissimmee Chain of Lakes since 2005 and, in more recent years, in Lake Okeechobee. WCA-3A has experienced modest, but not sustained, increases in nesting effort in recent years, although nesting success has been high in both 2014 and 2015. While this is encouraging, there is no evidence that native apple snail populations in WCA-3A have recovered or that habitat degradation there has stopped.

The Everglades ecosystem evolved to thrive under hydrologic conditions which varied, sometimes significantly, between and within years. The natural variability within the system resulted in a habitat mosaic which ensured long-term persistence of suitable habitat for Everglades wildlife, including snail kites and apple snails. The impoundment and management of this system has changed the timing, duration, and frequency of high and low water conditions, and has resulted in the apparent trade-offs observed between low and high water in WCA-3A. Under the managed system, drying events following rapid recessions have the potential to cause nest failure as well as mortality of apple snails and juvenile snail kites, whereas repeated and extended flooding tends to result in decreased apple snail productivity and long-term degradation of the habitat, which also reduces kite reproduction and hinders the species' recovery. In addition to avoiding frequent extreme and prolonged water levels (high or low), it is essential to incorporate proper (natural) timing of these water levels to better mimic natural hydro patterns.

4.3. EFFECTS OF THE ACTION

This section addresses the direct and indirect effects of the Action to the Everglade snail kite, including the effects of interrelated and interdependent activities. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

4.3.1. Direct Effects

The assessment of the effects of ERTP on the Everglade snail kite in the 2010 BO was based on modeling conducted by the Corps to evaluate the effects of ERTP Run 9E1, PMs and ETs developed for use in ERTP operations, and observed data that had been recorded during the operation of ISOP, ISOP 2001, and IOP. The effects of ERTP on snail kites were expected to be completely hydrologic since construction of IOP (MWD and C-111) structural features had already been completed. Major components of ERTP that were expected to affect the snail kite and its designated critical habitat included modifications of the WCA-3A Interim Regulation Schedule and removal of the S-12C IOP closure dates. These operational modifications were captured in the Corps' SFWMM modeling. Because the continuation of ERTP as proposed includes no changes to these operations, we first discuss the 2010 modeling results below, followed by a discussion of the actual hydrologic conditions experienced under ERTP in relation to potential effects to the snail kite. Additional components of ERTP-2016, designed to protect CSSS, are also discussed below. Lastly, Periodic Scientists Calls for WCA-3A, which were part of ERTP, will continue under ERTP-2016. These calls provide a mechanism to evaluate hydrological and ecological conditions within WCA-3A to allow for adaptive management of the system to protect the needs of multiple species, including the snail kite. Due to the inherent limitations of SFWMM modeling, this component of ERTP could not be modeled; therefore, our 2010 assessment of the potential effects of the Periodic Scientist Calls was limited to general conclusions. However, because we anticipated that the implementation of adaptive management would improve conditions for the snail kite in WCA-3A, our 2010 effects analysis was viewed as a "worst case scenario," and thus conservative for the species. Below, we evaluate the utility of Periodic Scientist Calls under ERTP toward implementing adaptive management in WCA-3A as intended.

4.3.1.1. *Evaluation of 2010 ERTP Modeling*

Modeling and analyses related to ERTP operations on the snail kite, the apple snail, and habitat suitability for these species were more detailed than those utilized in the previous evaluation of IOP, primarily due to the synthesis of new and longer-term data sets which encouraged the development of PMs and ETs. In addition, the timing of the ERTP evaluation allowed the Service, in retrospect, to better assess the effects of IOP on snail kites and apple snails. The Service recognized that IOP operations in WCA-3A likely reduced the suitability of the area for apple snails and nesting kites, at least in the short term. Decreases in suitable habitat, as well as the apparent significant decreases in population and estimated demographic parameters, also likely function to limit the snail kite's former resiliency to withstand extreme conditions and the normally short-lived, adverse effects such conditions would have on productivity and survival.

Under the managed system, drying events following rapid recessions have the potential to cause increased nest failures as well as mortality of apple snails and juvenile snail kites, whereas repeated and extended flooding tends to result in decreased apple snail productivity and long-term degradation of the habitat, which also reduces kite reproduction and hinders the species' recovery. In addition to avoiding frequent extreme and prolonged water levels (high or low), it is essential to incorporate proper (natural) timing of these water levels to better mimic natural hydropatterns. These general effects of water management on snail kites, apple snails, and their habitat are discussed in detail in the snail kite Environmental Baseline section above. ERTP-proposed modifications to IOP operations were designed, in part, to improve conditions for snail kites in WCA-3A through the reduction in prolonged high water conditions, moderation of extreme high and low water events – through less extreme water levels, shorter duration, decreased frequency, or a combination of these – and reduced recession rate and amplitude during the snail kite's breeding season. The specifics of these improvements were suggested in the Service's MSTS, and in the supporting science used in its development, as part of a comprehensive strategy for water management in WCA-3A during the transition from current to "restored" conditions, using increased snail kite productivity as a success criterion. Below, we describe SFWMM model results for Run 9E1 (ERTP) as part of our evaluation of the potential effects of ERTP.

4.3.1.2. *ERTP (2010) Evaluation Criteria for the Everglade Snail Kite*

As discussed in the snail kite Environmental Baseline section, the WCA-3A water regulation schedule has adversely affected snail kites as a result of three primary factors: 1) prolonged high water levels during September through January (or beyond in some years); 2) prolonged low water levels during the early spring and summer; and 3) rapid recession rates. The evaluation method used in 2010 to assess the effects of ERTP on the snail kite considered these factors as well, using criteria adapted from the MSTS (provided in 2010 ERTP BO) and outlined below. These criteria were also incorporated in four ERTP PMs and one ET for the snail kite, apple snail, and their habitat. Because PMs B and C address multiple factors for snail kites and apple snails, respectively, these PMs are addressed in multiple sub-sections below.

4.3.1.2.1. Prolonged High Water Criteria

Based on the potential for adverse effects to snail kites, apples snails, and their habitats as described in the Environmental Baseline section, the Service developed recommendations in the MSTS to guard against extended high water levels during the pre-breeding season (approximately January) and to provide favorable water levels associated with improved snail kite and apple snail productivity in the breeding (dry) season. These recommendations established the following criteria, as expressed as part of the following ERTP PMs:

Performance Measure B (Snail Kites) – Pre-breeding Water Levels: Strive to reach water levels measured by 3AVG between 9.8 and 10.3 ft NGVD by December 31. These water levels, measured by 3AVG when coupled with the recommended recession rate (0.05 ft per week, as described below), are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success during the peak breeding season (March-June). The Service determined it was most important to apply snail kite and apple snail PMs to conditions in southwestern WCA-3A, the area most frequently used by kites in recent years (Figure 24) and where adverse impacts to snail populations should be avoided or minimized.

Performance Measure C (Apple Snails) – Pre-breeding Water Levels: Strive to reach water levels between 9.7 and 10.3 ft NGVD by December 31. These water levels are based on reaching maximum water depths of 40 cm to 60 cm at the 3AVG average GSE of 8.34 ft NGVD. When coupled with a slow, gradual recession rate (approximately 0.05 ft per week), these water depths were recommended to provide favorable conditions (*i.e.*, water depths ≤ 40 cm, as discussed below) for apple snail egg production beginning in March, and to prevent delayed or reduced apple snail egg production.

Performance Measure C (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 and 9.7 ft NGVD between May 1 and June 1. The top end of the specified range (*i.e.*, 9.7 ft, measured using the 3AVG) is related to a depth of 40 cm at the 3AVG average GSE of 8.34 ft NGVD. As discussed above, snail research results suggest that this approximate water depth acts as a threshold in its effects (positive or negative) on apple snail productivity in a given year. It is important to note that, in the MSTS, the Service recognized that the stages will result in deeper water (*i.e.*, > 40 cm) in southern WCA-3A, which would negatively impact snail egg production in that area, and consequently reduced the top end of the multi-species recommended dry season range to 9.3 ft NGVD (measured using the 3AVG). Our evaluation took this discrepancy into account.

In addition to the PMs described above, our evaluation in 2010 also considered the effect of prolonged high water on snail kite nesting and foraging habitat. This metric was not incorporated into ERTP modeling directly because the MSTS does not contain a recommendation specific to snail kite nesting or foraging habitat to address a high water threshold during the wet season. However, the Service considers prolonged high water levels during the wet season important to evaluate based of the potential for ERTP operations to affect high water conditions in WCA-3A and in keeping with our 2002 and 2006 Biological Opinions issued for IOP, in which the Service concluded that IOP would not relieve high water levels that have caused declines in the condition of nesting and foraging habitat in WCA-3A. In our 2006 amended ITS for IOP, the Service concluded that if water levels rose above 10.5 ft NGVD at the 3AS3W1 gauge for 80 consecutive days in 3 consecutive years, incidental take would be exceeded.

To evaluate potential effects of wet season high water levels under ERTP on snail kites, we examined both observed water levels in WCA-3A from 1992 to 2010, and reviewed SFWMM model results for any available inference. Because there was no ERTP PM specific to wet season high water levels and snail kite nesting or foraging habitat, and SFWMM model output did not include stage data for gauge 3AS3W1, we were not able to directly evaluate the performance of ERTP versus IOP with regard to meeting the 2006 IOP incidental take high water threshold (stage, duration, or frequency). However, both the MSTS and ERTP PM-I include a 3AVG high water level threshold of 10.8 ft intended to minimize impacts to tree islands in WCA-3A. Using these metrics, performance of LORS and Run 9E1 were compared to assess the potential for ERTP to reduce wet season maximum water levels and to meet the related IOP incidental take criteria.

4.3.1.2.2. Low Water Criteria

The intent of low water evaluation criteria was twofold; 1) to assess the potential for frequent and extended extreme low water levels which would result in reduced snail kite reproduction and recruitment, and reduced apple snail productivity and juvenile survival, and 2) to assess the opportunities for lower (but not extreme, frequent, or extended) water levels which are essential to restoration and maintenance of wet prairie habitat, and which species experts believe are necessary, at least in the transition period, to return WCA-3A to a productive kite area. Based on the information described in the snail kite Environmental Baseline section, the Service developed recommendations in the MSTS to provide favorable water levels associated with improved snail kite and apple snail productivity in the breeding (dry) season. Recommended water levels were intended to represent the annual minimum stage which typically occurs sometime in May before the onset of wet season rains. These recommendations established the following criteria, as expressed as part of the following ERTP PMs and ET:

Performance Measure B (Snail Kites) – Dry Season Water Levels: Strive to reach water levels between 8.8 and 9.3 ft between May 1 and June 1. These water levels (measured using the 3AVG) are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success and juvenile survival, balanced with the need for lower water levels during the dry season to avoid negative effects to wet prairie vegetation.

Performance Measure C (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 (emphasis added) and 9.7 ft between May 1 and June 1. The bottom end of the specified range (*i.e.*, 8.7 ft, measured using the 3AVG) is related to a depth of 15 cm at the 3AVG average GSE of 8.34 ft NGVD. This water level translates to dry season minimum water depths ≥ 10 cm at GSE < 8.36 ft NGVD, and thus, should avoid negative effects to snail movement and reproduction in these areas.

Ecological Target 3 (Wet Prairie) - Hydroperiod: In dry years, strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in 4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water levels below ground surface for more than 4 to 6 weeks to minimize adverse effects on apple snail survival.

4.3.1.2.3. Recession Criteria

Based on the information described in the Environmental Baseline section, the Service developed a recession recommendation for snail kites in the MSTS, and this recommendation established the following criteria, as expressed as part of the following ERTP PM:

Performance Measure D (Snail Kites) – Dry Season Recession: Strive to maintain a recession rate of 0.05 ft per week from January 1 to June 1 (or the onset of the wet season). This equates to a stage difference of approximately 1.0 ft between January and the dry season low. The Service defined the onset of the wet season as a sustained increase in water levels associated with increased rainfall frequency, which has occurred prior to June 1 over 50 percent of the time since 1965. The recession rate guideline is most important to follow during the peak snail kite breeding season (March-June). Recession rates > 0.05 ft but < 0.10 ft per week, while generally more rapid than desired, may be considered acceptable under certain environmental conditions (*e.g.*, unseasonably heavy rainfall). Rates > 0.0 and < 0.05 ft per week are not associated with direct negative impacts to nesting snail kites, although rates approaching 0.0 ft may result in delayed or reduced snail egg cluster production, depending on water depths at that time (*i.e.*, greater impacts when water is > 40 cm deep).

4.3.1.3. *Everglade Snail Kite 2010 Evaluation Results*

The ERTP WCA-3 Interim Regulation Schedule incorporates the WCA-3A 1960 9.5 to 10.5 ft NGVD Zone A, along with expansion of Zone D forward to December 31 and expansion of Zone E1 backwards to January 1. In its ERTP-2016 BA, the Corps describes the intent and objectives of the modifications as follows:

"Zone E1 was designed to aid in the management of high water levels within WCA-3A in order to alleviate prolonged high water conditions in WCA-3A during closure of the S-12, S-343 and S-344 structures. The creation of Zone E1 permitted the lowering of water levels by 0.5 feet lower than regulations prior to the implementation of this zone. Water from WCA-3A is transferred through S-333 and S-334 into the L-31N Canal and pumped via S-332B into the S-332B west seepage reservoir. This modification was designed to further aid in the reduction of high water levels within WCA-3A; and specifically to address the protracted flooding that occurred between September and January under IOP. The intent of expanding Zones D and E1 was to achieve the ERTP objective of managing water levels within WCA-3A for the protection of multiple species and their habitats (ERTP PM B-I). Through this modification, USACE has additional flexibility as compared with IOP WCA-3A Regulation Schedule in making water releases from WCA-3A in order to better manage recession and ascension rates, as well as to alleviate high water conditions in southern WCA-3A."

Our 2010 evaluation of the ability of ERTP to meet these objectives, and a comparison of ERTP versus IOP performance, assessed using SFWMM modeling ERTP PMs and ETs, are discussed below. Because our 2010 climate analysis indicated that south Florida has been in a "wetter" regime since the early 1990s and was expected to remain so for the next 5 to 10 years, we evaluated these effects during two time periods – the model period of record (1965 to 2000) and the last 10 years during this period (1990-2000), which we anticipated best represented conditions that would exist during the period of ERTP operations. For most of our comparisons, the overall performance of IOP and ERTP (*i.e.*, whether ERTP resulted in improved or worsened conditions) did not differ. However, the degree of difference between the model runs was often reduced when considering the 1990-2000 time period as opposed to the entire period of record; this was typically the case for differences related to high water conditions (*i.e.*, frequency above recommended ranges).

4.3.1.3.1. Prolonged High Water Criteria

Performance Measure B (Snail Kites) – Pre-breeding Water Levels: Strive to reach water levels between 9.8 and 10.3 ft NGVD by December 31.

Performance Measure C (Apple Snails) – Pre-breeding Water Levels: Strive to reach water levels between 9.7 and 10.3 ft NGVD by December 31.

ERTP modeling results suggested that, for both time periods under consideration, ERTP operations would result in somewhat lower water levels during the pre-breeding season (January) when compared to IOP. Specifically, model results showed a decrease in the frequency that 3AVG stages would be above the recommended ranges for both snail kites and apple snails (for 1990 to 2000, 18.2 percent less often under Run 9E1 versus LORS in both PM-B and PM-C), and an increase in the frequency that stages would be within the recommended pre-breeding ranges for these species (for 1990-2000, increases of 9.1 and 18.2 percent under Run 9E1 in PM-B and PM-C, respectively) (Figures 25, 26). For PM-B, related to snail kite recommended water levels, model results for the entire period of record also suggested a slight increase in the frequency that 3AVG stages would be below the recommended range (8.3 percent increase under Run 9E1); because this is not the case for PM-C, these decreases in stage must be minor (*i.e.*, a decrease from > 9.8 ft to > 9.7 ft NGVD). Overall, these results represented improvements to pre-breeding hydrologic conditions in WCA-3A from ERTP operations compared with those of IOP.

Performance Measure C (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 and 9.7 ft (emphasis added) NGVD between May 1 and June 1.

For evaluating whether maximum water levels during the dry season would be suitable for apple snail reproduction (*i.e.*, < 40 cm from April through June), the Service focused on ERTP modeling results related to the frequency that dry season water levels were above the recommended range for apple snails during May. Model results suggested that, for both time periods under consideration, ERTP operations are unlikely to significantly lower maximum water levels during the dry season when compared to IOP, as indicated by the frequency that 3AVG stages would be above the recommended ranges for apple snails (for 1965-2000, 2.7 percent less often under Run 9El; no differences for the 1990-2000 time period) (Figure 27). The Service also reviewed the frequency that WCA-3A water levels were above the MSTS multi-species recommended dry season range (8.4 to 9.3 ft), which takes into account the intent to benefit snail populations in southwest WCA-3A and the differences in water depths in southern WCA-3A versus those represented by the 3AVG. Model results for the entire period of record suggested that ERTP operations may result in slightly lower maximum water levels during the dry season compared to IOP, as indicated by a 5 percent decrease in the frequency that 3AVG stages would be above the MSTS range (Figure 28).

In addition to evaluating these three high water-related PMs, we also evaluated potential effects of ERTP in relation to meeting the prolonged high water criteria used in our 2006 amended ITS for IOP. We reviewed stage data for gauge 3AS3W1 from 2000 (the beginning of its period of record) through 2009, and for gauge 3A-28 (also known as Site 65) from 1992 through 2009, to determine how often this threshold was exceeded during that timeframe. We compared stages between these two gauges (Table 22), and determined that pre-2000 water levels at the location of 3AS3W1 can be generally inferred by looking at 3A-28 stages – based on the average stage difference of 0.13 ft between these gauges, if the stage at 3A-28 was > 10.4 ft, than it is highly probable that the location of gauge 3AS3W1 would have been >10.5 ft.

Based on our review, we determined that water levels at 3AS3W1 exceeded 10.5 ft during 14 of the 18 years (1992-2009). During these 14 years, water levels > 10.5 ft for 80 days or more occurred during 6 years – 1994, 1995, 1999, 2003, 2005, and 2008 (Table 23), only 2 of which were consecutive (1994 and 1995). Additionally, water levels exceeding 10.5 ft for somewhat shorter durations (> 60 but < 80 days) occurred in 2004, resulting in a 3-year period of relatively high, extended wet season water levels in southwest WCA-3A (2003 to 2005; Table 23). During these years, Darby et al. (2005) documented the dramatic decline in snail densities at sample sites in WCA-3A as discussed in the Environmental Baseline section. These high water levels likely resulted in immediate adverse impacts to apple snail reproduction in 2003 and, potentially, long-term adverse impacts to wet prairie habitat from 2003 to 2005. Such long-term impacts to habitat may, in part, explain the continued low densities of snails found by Darby et al. from 2005 to 2007 despite apparently suitable dry season water depths in central and southern WCA-3A during those years. This could also explain the slower than expected recovery of snails in WCA-3A. Wet prairie habitat not only serves as prime habitat for snail reproduction, but also as prime foraging habitat for kites due to higher snail densities and availability in wet prairie as compared to open water sloughs, or dense sawgrass or emergent communities (Darby 2008). In addition to observed changes in snail productivity and densities, data also indicated a decrease in snail kite nest success after 2004, from an average of 37 percent nest success during 1996 to 2004 to an average of 10 percent during 2006 to 2009 (note there was no kite nesting in WCA-3A during 2001, 2005, or 2008) (Table 21). This drop in nest success could reflect negative impacts to the kite's foraging opportunities, due to decreased snail density, availability, or to nesting habitat, or a combination of these.

While it is commonly observed that wet prairie habitat requires periodic dry downs during the spring for plant regeneration, it has also been documented that Everglades wet prairies occur in areas with typically lower wet season water depths (relative to sloughs). Based on management observations, Dineen (1974) recommended a "wet prairie" regulation schedule for WCA-2A that included a wet season high water level of 12.5 ft; using the average GSE in WCA-2A (10.5 ft NGVD), this equates to a wet season water depth of approximately 2.0 ft. No duration was recommended, but the regulation schedule reflects a high water peak occurring at the end of October and receding immediately thereafter. Goodrick (1974) reported on wet season water depths during 1963-1972 at both a wet prairie site (near gauge 3-2, north of Alligator Alley) and a slough site (near gauge 3A-28) in WCA-3A. He found that October water depths in the wet prairie site never exceeded 2.3 ft, compared to slough water depths which exceeded 2.5 ft approximately 40 percent of the time. These observations suggest that water depths > 2.5 ft are more conducive to slough vegetation (*Nymphaea* and submerged species), and that such wet season water levels have the potential to contribute to the conversion of wet prairies to slough. Maintaining water levels at such depths for prolonged periods of time would serve to increase the potential for this to occur. In addition, increasing the frequency of this occurrence in consecutive years could also increase the likelihood of wet prairie degradation and conversion. Recent research indicates that shifts from one vegetation type to another may occur in a relatively short time frame (1 to 4 years) following hydrological alteration (Armentano et al. 2006; Zweig 2008; Zweig and Kitchens 2008; Sah et al. 2008).

Duration of wet season high water levels may also be correlated to snail kite and apple snail reproductive success in that it affects the likelihood of meeting the recommended January 1 water levels which are described in the MSTS and incorporated into ERTP PMs B and C. Our review of stage data for gauge 3AS3W1 indicated that, during years when the wet season stage exceeded 10.5 ft and remained above this threshold past late November, January 1 water levels as measured by the 3AVG were higher than those recommended for snail kites and apples snails (Table 23). From 2000 through 2009, the average date that water levels at 3AS3W1 exceeded 10.5 ft was September 16, with a range of August 25 to September 30.

To evaluate the performance of IOP and ERTP model runs with regard to meeting the tree island high water threshold specified in the MSTS and ERTP PM-I (*i.e.*, 10.8 ft as measured by the 3AVG), we reviewed both the frequency that WCA-3A water levels were above or below the wet season threshold, and the number of days above the threshold, over the entire period of record. Model results did not show a difference between the frequency at which IOP and ERTP exceeded the MSTS wet season recommended water level (*i.e.*, 10.8 ft for tree islands), with both models exceeding this threshold 33 percent of the time from 1965 to 2000 (Figure 29). However, during years in which the stage exceeded 10.8 ft, Run 9E1 did perform better than LORS by reducing the number of days that water levels stayed above this threshold in some years (Figure 29). Based on our comparison of stage data (Table 22), the 10.8 ft threshold for PM-I would translate to an approximate stage of 10.57 ft at gauge 3AS3W1 or less than 0.10 ft difference from the 10.5 ft IOP threshold. Our evaluation indicated that, while ERTP operations would probably not result in less frequent high water peaks (> 10.5 ft) in WCA-3A, they could result in a decrease in the duration of these high water conditions in some years. Because vegetation studies suggest that duration is a key factor in habitat conversion and the effects on specific plant species, these slight decreases represented an improvement of ERTP operations over those of IOP and could potentially slow the trend of conversion of wet prairie to slough communities.

Our 2010 evaluation acknowledged that the ability of ERTP to achieve the hydrologic improvements shown in the SFWMM modeling depends on the Corps' ability to store water north of WCA-3A or move water out of WCA-3A during high water conditions. Hydrologic conditions during the last 10 years under IOP had suggested that this may not be possible due to limitations of the C&SF Project infrastructure currently in-place. Advisors to the C&SF Project Comprehensive Review Study (Corps 1999) asked the project delivery team to, "increase the use of Central Lake Belt storage and to design a variable crest weir along L-67, both of which were intended to extend the period of continuous flooding through the dry season in Shark River Slough and reduce the severity of extreme drying and flooding events in eastern WCA-3A and WCA-3B." ERTP is a transitional plan that is not yet able to utilize the new features currently being planned as part of CERP. Therefore, until completion of CERP water storage and restoration projects or reintroduction of sheetflow through WCA-3B to NESRS, performance of ERTP still depends heavily on the Corps' ability to accurately predict future meteorological conditions and manipulate water levels within the old infrastructure of the C&SF Project.

4.3.1.3.2. Low Water Criteria

Performance Measure B (Snail Kites) – Dry Season Water Levels: Strive to reach water levels between 8.8 and 9.3 ft between May 1 and June 1.

Performance Measure C (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 (emphasis added) and 9.7 ft between May 1 and June 1.

Ecological Target 3 (Wet Prairie) - Hydroperiod: In dry years, strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in 4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water levels below ground surface for more than 4 to 6 weeks to minimize adverse effects on apple snail survival.

Results of ERTP modeling indicated minimal improvements in WCA-3A dry season stages under ERTP operations. Results for PM-B from 1990 to 2000 suggested that ERTP dry season water levels would fall within the snail kite recommended range more often (by 18.1 percent) than under IOP, although this improvement was entirely related to reduction in water levels above the recommended range (Figure 30). However, results for 1965-2000 suggested a slight increase (2.8 percent) in frequency of water levels below the recommended range; no differences were observed for the 1990-2000 time period. Results for PM-C for both time periods suggested no differences between dry season low water levels under ERTP and IOP operations (Figure 27). Results for ET-3 from 1965 to 2000 suggest that ERTP operations may result in slightly increased frequencies and duration of dry downs in southern and central WCA-3A (gauges 3A-28 and Site 64, respectively) (Figure 31). Given the prolonged hydroperiods observed in WCA-3A since 1992 (and which have likely contributed to loss of wet prairie habitat), increased opportunities for drying events that do not greatly increase the duration of these events, generally represent an improvement over IOP operations. However, when the time period under consideration was constrained to 1990-2000, this expected improvement was reduced as post-1992 wet conditions prevented any dry downs from occurring at gauge 3A-28 under either IOP or ERTP modeled operations. Overall, model results suggested minimal to no dry season improvements for snail kites, apple snails, or their habitat.

4.3.1.3.3. Recession Criteria

Performance Measure D (Snail Kites) – Dry Season Recession: Strive to maintain a recession rate of 0.05 ft per week from January 1 to June 1 (or the onset of the wet season). This equates to a stage difference of approximately 1.0 ft between January and the dry season low.

The SFWMM model results indicated minor improvement in the dry season recession rate as a result of ERTP operations compared with those of IOP (Figure 32). The frequency at which the recommended average weekly recession rate (0.05 ft per week) was met increased by only 1-2 percent depending on the time period considered. More importantly (for nesting snail kites and their young), these minor improvements primarily resulted from decreases in recession rate (*i.e.*, decreased frequency of rates > -0.10 ft per week, -0.06 to -0.10 ft per week, or both). In contrast, model results for amplitude suggest ERTP operations result in increases to dry season amplitudes compared with those under IOP (Figure 33). For example, for the time period 1990 to 2000, ERTP failed to hit the recommended amplitude during any years, compared to approximately 18 percent of the time under IOP. Within this time period, there was an expected 27.2 percent increase in moderately high (1.15 to 1.74 ft) amplitudes and a 9 percent decrease in extremely high (≥1.75 ft) amplitudes. After further review of these results, we determined that this comparison was extremely sensitive to slight changes in the numbers used for the category boundaries – changing the range of categories by 0.05 ft (*i.e.*, changing the recommended amplitude from 0.85 to 1.14 ft and 0.90 to 1.19 ft) reduced this observed difference by half (from 18 to 9 percent). The differences in relative model run performance between the amplitude metric and the recession rate metric were also likely due to the method of calculation rather than actual differences in operations. These issues, in conjunction with the undefined model error, put into question what recession-related differences would actually be observed between IOP and ERTP operations. A comparison by the Corps of the actual dry season amplitude at gauge 3A-28 for the period between February 1 and May 1 from 1998 to 2009, with the ERTP-recommended recession (0.60 ft amplitude for the same time period based on 0.05 ft per week), indicated that the ERTP-recommended amplitude was not met in any year since 1998. The Corps also suggested that rapid dry season recessions during IOP were associated with the creation of Zone E-1. With the expansion of this regulation zone back to January 1 under ERTP, our 2010 evaluation determined that it would be even more important to actively evaluate and adjust water management operations using the guidelines in ERTP PM-D to avoid adverse impacts to nesting kites and their young. The mechanism for doing so was to be the Periodic Scientist Calls, as described below.

4.3.1.4. *Evaluation of Conditions under ERTP (Water Year 2013 - present)*

The following summary describes actual hydrologic conditions experienced since ERTP was implemented in October 2012 (*i.e.*, beginning of Water Year 2013) and compares differences in relation to pre-ERTP trends, expected conditions per 2010 ERTP modeling, and Incidental Take and reinitiation triggers specified in the 2010 ERTP BO.

4.3.1.4.1. <u>Prolonged High Water</u>

From approximately 1966 to the early 1990s, we experienced the last cool phase of the AMO, resulting in overall drier conditions during those years. The current warm phase of the AMO began in the early 1990s, leading to a wetter climate regime since that time, with the peak likely occurring from around 1992-2006. Hydrological modeling of IOP Alternative 7R in 2002 indicated that implementation of IOP would not relieve high water levels within WCA-3A and, in fact, would result in excessive ponding and extended hydroperiods, further contributing to declines in the condition of nesting and foraging snail kite habitat in WCA-3A (Corps 2006; Service 2002, 2006a). During 1992-2010, 3AVG average annual minimum and maximum stages were approximately 1.0 ft higher than averages during 1965-1991. From 1992 through 2010, 3AVG stage exceeded 10.5 ft NGVD in every year except 2007, and exceeded 11.5 ft NGVD in 6 of those 19 years. While ERTP modifications to IOP regulations and the WCA-3A Regulation Schedule were designed to reduce water levels within WCA-3A, the Service recognized in 2010 that the potential improvements were not expected to be sufficient to prevent continued habitat degradation or to entirely eliminate negative impacts to snail kite and apple snail productivity in all years.

Since 2011, 3AVG average annual maximum stages have decreased somewhat to 11.1 ft NGVD (0.5 ft decrease compared to the 1992-2010 average maximum), although this was likely largely driven by consecutive La Nina events in 2010-2011 and 2011-2012. Since ERTP was implemented in October 2012, 3AVG maximum stage has averaged 11.1 ft NGVD, ranging from a high of 11.6 ft NGVD in 2013 to a low of 10.6 ft NGVD in 2015. These maximum stages have occurred within the wet season, and, in 2014 and 2015, were not prolonged. However, 3AVG stage was above 10.5 ft NGVD during August-December 2012 and again during July-November 2013. During this latter period, 3AVG stage exceeded 10.8 ft NGVD (2010 habitat evaluation threshold as discussed above) for 100 consecutive days, from July 14-October 21, 2013.

In our 2010 BO, the Service identified a wet season (June 1 – December 31) high water incidental take exceedance criteria as follows: stage above 10.5 ft NGVD at gauge 3AS3W1 for 60 consecutive days in 2 consecutive years as a result of ERTP operations (or continued IOP operations, prior to ERTP implementation). Since ERTP was first implemented, water levels exceeded this threshold stage once, rising above 10.5 ft NGVD at gauge 3AS3W1 for 70 consecutive days from July 23-September 30, 2013. The Corps' Annual Assessment Report for Water Year 2013 states:

"As reported at Gauge 3AS3W1, higher than average precipitation occurred during the months of May through July 2013. All structure discharges were maximized to the extent practicable to alleviate high water conditions within WCA-3A. In response to the higher than average precipitation, USACE (or its local sponsor, South Florida Water Management District) completed several actions to address high water conditions in WCA-3A during 2013. The response included construction of a temporary gap of the Old Tamiami Trail adjacent to the S-346 structure and completion of surveying required for vegetation management south of the S-12B structure.

In addition, USACE released an Environmental Assessment for a planned deviation for the G-3273 stage constraint. This action was not finalized due to State of Florida concerns over water quality and flood protection within the South Dade Conveyance System. In addition, lack of acquisition of the necessary easements to raise water levels within Everglades National Park also prevented a Finding of No Significant Impact. Other USACE proposals to address high water concerns within WCA-3A included L-29 Borrow Canal Stage Constraint, WCA-2A Regulation Schedule, WCA-3B Stage Constraint, S-197 Proactive Opening and consultation with FWS regarding Cape Sable seaside sparrow closure periods. Each of the options was rejected based upon individual constraints.

USACE has concluded that water levels above 10.5 feet NGVD were the result of natural rainfall conditions and not a result of operations prescribed by 2012 ERTP. In addition, USACE utilized all available means of removing water from WCA-3A and thus has concluded that reinitiation is not required at this time."

ERTP evaluation criteria for prolonged high water focused on pre-breeding water levels for snail kites and apples snails, and dry season water levels for apple snails. As discussed above, pre-breeding 3AVG stage targets were identified as (1) between 9.8 and 10.3 ft NGVD by December 31 for snail kites (ERTP PM-B), and (2) between 9.7 and 10.3 ft, NGVD by December 31 for apple snails (ERTP PM-C). Since ERTP has been implemented, water levels on December 31 have been within these preferred depth ranges except during December 2015, when the December 31 3AVG stage was 10.5 NGVD. High water levels have continued into 2016, during which El Nino rainfall has overwhelmed the system and contributed to drastic increases in WCA-3A water levels (nearly 1.0 ft within a two-week period, reaching approximately 11.5 ft NGVD in February).

The dry season 3AVG stage target for apple snails was identified as between 8.7 and 9.7 ft NGVD between May 1 and June 1. The high water threshold of this PM (*i.e.*, 9.7 ft) has been met in every year since ERTP was implemented. However, the Service's 2010 BO also identified dry season high water incidental take exceedance criteria as follows: stage above 9.2 ft NGVD at gauge 3AS3W1 by April 15 in 2 consecutive years as a result of ERTP operations (or continued IOP operations, prior to ERTP implementation). Since ERTP was first implemented, water levels exceeded this threshold stage once, rising above 9.2 ft NGVD for 30 days between April 15 and May 31, 2013. The Corps' Annual Assessment Report for Water Year 2013 states:

"As required by 2012 ERTP, S-12A, S-12B, S-343A, S-343B and S-344 were closed through July 14, 2013 for protection of Cape Sable seaside sparrow (CSSS); therefore, these structures were unavailable for water releases from WCA-3A. USACE has concluded that operations of the remaining outlet structures were consistent with the Rainfall Plan and in accordance with 2012 ERTP, therefore, USACE has concluded that high water conditions between April 15 and May 31, 2013 were the result of rainfall and not USACE water management operations. Under ERTP, water managers have the additional benefit of the use of S-12C and therefore have a greater potential to meet WCA-3A depth requirements as compared with the 2006 IOP. In addition, WCA-2A water levels remained in Zone A for the duration of the dry season and the 2013 wet season, allowing for the ability to make maximum releases to WCA-3A. During the time period from April 15 to May 31, while stages were between 0.5 and 1.0 feet above the bottom of Zone A, releases were minimized as much as possible in order to limit the potential adverse effects of additional water being added into WCA-3A."

The observed water levels since October 2012 are in keeping with the Service's 2010 ERTP evaluation, which suggested only minor improvements related to prolonged high water (*i.e.*, decreased maximum water levels or frequency of high water conditions) compared to conditions under IOP. It is unclear whether, or to what degree, ERTP has contributed to reducing the level or duration of high water levels within WCA-3A, versus effects of overall drier climatic conditions. Retrospective analysis indicates that the AMO warm phase has been weakening since 2006 with annual rainfall amounts and hurricane activity also diminishing throughout the Everglades system. Thus, the wetter than normal conditions caused by the AMO that Florida experienced from the early 1990s through the mid-2000's should continue to slowly decline through the next 5 to 10 years. As we approach the end of the cycle, Florida will experience an increase in drier years than wet years. For ERTP-2016 evaluation purposes, south Florida's annual rainfall trends will continue to decline, which should increase the likelihood and frequency of meeting high water-related targets. However, as observed during periods of above average precipitation due to other events such as El Nino, ERTP operations are too limited to affect meaningful reductions in WCA-3A high water levels.

4.3.1.4.2. Low Water

Under the IOP regulation schedule, there was a high likelihood that the water levels in WCA-3A would fall below a critical threshold, below which snail kite foraging success and apple snail reproduction was severely reduced, for an extended period of time. Zone E1 was first incorporated into the WCA-3A Interim Regulation Schedule under ISOP and subsequently included in IOP. The 0.5-ft reduction in the bottom zone (Zone E) of the WCA-3A Interim Regulation Schedule for IOP was intended to help offset the effects of reduced outflows in the dry season and early wet season. This change, as simulated in the SFWMM, resulted in a greater reduction in WCA-3A stages prior to the wet season. While this new zone may have helped to achieve the desired result of reducing high water impacts that could result during the early wet season, it likely resulted in detrimental impacts to snail kite nesting and foraging within WCA-3A. During the years of ISOP and IOP operations (from 1998 to 2012), dry season low stages (as indicated by gauge 3A-28) averaged approximately 8.4 ft NGVD, with the exception of 2003, when the low reached 8.9 ft. In the 5 years prior to IOP, the low stages at gauge 3A-28 averaged approximately 9.0 ft. From 1998 to 2012, 3AVG annual minimum stage averaged 8.6 ft NGVD. Since ERTP was implemented in October 2012, dry season low stages have averaged 8.5 ft NGVD at gauge 3A-28, and 8.8 ft NGVD for 3AVG.

ERTP evaluation criteria for low water concerns focused on dry season water levels for snail kites (PM-B) and apple snails (PM-C). ERTP PM-B identified target 3AVG water levels between 8.8 and 9.3 ft NGVD between May 1 and June 1 for snail kites. Since ERTP has been implemented, minimum water depths between May 1 and June 1 were above the preferred range in Water Year 2013, below the preferred range in Water Year 2014, and within the preferred range in Water Year 2015. Although PM-B was not met in Water Years 2013 or 2014, the Corps attributed the water depth variations to rainfall experienced throughout WCA-3A. For example, in 2013, the dry season low water level (9.2 ft NGVD) was actually reached earlier than usual, at the beginning of April. In May 2013, nearly 9.0 inches of rainfall was reported for WCA-3AVG, resulting in stages exceeding the maximum preferred May 1 to June 1 depth range of 9.3 feet NGVD. During this period of time, WCA-3A outlet structures, S-12A, S-12B, S-343A, S-343B and S-344 were unavailable for use due to mandated CSSS closure periods. The S-12D, S-333 and S-334 structures were discharging during this period and S-12C began discharges in accordance with WCA-3A Interim Regulation Schedule on May 7, 2013. In 2014, the Corps attributed the lower than preferred water depths during May 1 to June 1 to a combination of lack of rainfall and evapotranspiration experienced throughout the region (9.4 inches between January 1 and June 1). During this period (April 1 to June 1, 2014) only S-333 and S-334 were opened to deliver water supply to the Lower East Coast.

ERTP PM-C identified target 3AVG water levels between 8.7 and 9.7 ft NGVD between May 1 and June 1 for apple snails. The low water threshold of this PM (*i.e.*, 8.7 ft) has nearly been met in every year since ERTP was implemented, with the minor exception of 3AVG stage hovering near 8.6 ft NGVD for five days at the end of May in 2014. In 2015, 3AVG water levels continued to decrease from June into August, but did not drop below the recommended 8.7 ft NGVD.

Based on our 2010 evaluation (PMs B and C, and Ecological Target 3), minimal to no improvements in WCA-3A dry season stages were expected under ERTP operations compared to IOP. Thus, actual conditions under ERTP since October 2012 have been at least as good as anticipated, and possibly somewhat better in relation to target dry season water levels for apple snails.

Since the 2010 ERTP Biological Opinion was written, Florida experienced a 2-year drought (2010-2012); with 2012 being the fifth year of drought in the last 15 years, and the second occurrence of consecutive year droughts during that time. This represents a higher frequency of drought than anticipated or considered in our 2010 ERTP analyses, suggesting that additional climate factors (relating to the El Nino Southern Oscillation) are causing increased frequency and intensity of weather extremes, such as the consecutive La Nina events in 2010-2011 and 2011-2012. Snail kites are adversely impacted by these extremes, and are less resilient to such events given their reduced population size. The Service recognized this risk in our 2012 ERTP BO amendment, in which we recommended using caution when implementing the ERTP schedule. In particular, while expanding Zone E1 backward to January allows for increased flexibility to reduce wet season high water conditions, it could have the inadvertent effect of lowering water levels too much, especially during or preceding drought years. In addition, ERTP still lacks the needed flexibility to retain water during such years - such an improvement will be required in future operational plans in order to realize the needed improvements to kite nesting conditions in WCA-3A.

4.3.1.4.3. <u>Recession Rates</u>

The Incidental Take Statement - Dry Season Recession requirement (for January 1 to May 31) was to not exceed 1.7 ft. for 2 consecutive years. The Corps met this requirement from 2012 to 2015 as follows:

- 2012 = 1.2 ft.;
- 2013 = 0.58 ft.;
- 2014 = 1.55 ft.; and
- 2015 = 1.27 ft.

The Incidental Take Statement - Dry Season 30-day Rolling Average Recession requirement was to not exceed 0.34 ft. for 2 consecutive years (Jan. 1 through May 31). The Corps did not meet this requirement for ERTP performance from 2012 through 2015 as follows:

- 2012 = Exceeded March 11 through April 22 (43 days);
- 2013 = Exceeded March 28 through April 4 (8 days);
- 2014 = Exceeded March 13 through March 31 and May 20 (51 days); and
- 2015 = Exceeded March 30 through April 20 and May 29 through May 31 (25 days)

The exceedance of the 30-day rolling average recession rate performance measure may be due to seepage (ground water reduction or removal from outside of the WCA areas), because it does not appear to be simple function of surface water in or out of the conservation areas. The current ERTP still lacks the needed information to assess why this performance measure has not been met, and it is recommended that the Corps evaluate these recession rates with the continuation of the ERTP schedule.

4.3.1.5. *Additional ERTP-2016 Components*

In the Corps' ERTP-2016 BA, four main measures identified during informal consultation that may act to further protect CSSS were discussed: 1) MWD Increment 1 Field Test; 2) operational flexibility within ERTP; 3) a Water Flow Analysis Test; and 4) exploring options for plugging or gapping of the L-28 Borrow Canal to prevent flows into western CSSS-A. Operational flexibility within ERTP is evaluated above, based on the actual conditions experienced since ERTP was implemented beginning in October 2012. The three remaining measures are discussed below.

4.3.1.5.1. <u>MWD Increment 1 Field Test</u>

The field test is an operational plan that is expected to benefit ENP by increasing flows to NESRS. By reducing limitations on S-333, potentially more water will be delivered to NESRS. The 2015 Environmental Assessment and Finding of No Significant Impact for the MWD Increment 1 Field Test includes a hydrologic assessment of potential effects to WCA-3A, NESRS, and the SDCS that was conducted using the historical period from July 2002 (initial IOP operations) through June 2014 (start of Increment 1 development). The field test is expected to increase the number of unconstrained discharges from WCA-3A to NESRS by up to 1,176 days, a 64 percent increase relative to the current ERTP, with the majority of increased flows to NESRS anticipated during the months of June through December. During the field test, stage levels experienced at G-3273 and other locations within NESRS are expected to be similar to the intra-annual range of water stages experienced under recent C&SF Project operations. The duration at which water stages at G-3273 exceed 6.8 feet NGVD is expected to increase. A potential increase in hydroperiods within NESRS may provide an overall net benefit for snail kites and apple snail habitat. Increases in volume into NESRS provide an opportunity for improved vegetation, including expansion of sloughs and wet prairies, and contraction of sawgrass ridges. However, due to the short duration of this test, significant vegetation changes are not anticipated.

WCA-3A represents the largest and most consistently utilized portion of snail kite designated critical habitat. Over the past two decades, snail kites have shifted nesting activities to areas of higher elevation within WCA-3A in response to habitat degradation in traditional nesting areas resulting from prolonged high water levels. Nesting activity has shifted up the elevation gradient to the west, and has also moved south in response to recent increased drying rates, restricting current nesting to the southwest corner of WCA-3A. The field test includes a seasonally varying WCA-3A water level of 10.0 to 10.75 feet NGVD (*i.e.* Increment 1 Action Line), as measured by 3AVG, which will serve to define S-333 and S-356 releases to L-29 Canal and NESRS. Implementation of the Increment 1 Action Line as a criterion to suspend S-356 pumping into the L-29 Canal will assist with management of high water conditions in WCA-3A and would prevent conditions of extreme high water levels and prolonged inundation periods within WCA-3A as a result of field test operations.

Based on this information and the limited duration of the field test, in a Complete Initiation Package sent to the Service on January 6, 2015, the Corps determined that implementation of MWD Increment 1 Field Test may affect, but is not likely to adversely affect, this species and its designated critical habitat. The Service concurred with this determination in our letter dated February 10, 2015. Because the field test did not begin in October 2015, and the Corps has not yet provided a final report of the effects of this test, we are unable to update our evaluation of effects to the snail kite at this time.

4.3.1.5.2. <u>Water Flow Analysis Test</u>

A Water Flow Analysis Test was proposed allow for a better understanding of directionality of flow entering CSSS-A habitat to determine whether additional operational modifications to

S-12A, S-12B, S-343A, S-343B and S-344 structures are needed or whether other yet to be identified additional measures may be needed to prevent western flows into CSSS-A. Although recommended by the Corps in the 2015 BA, subsequent discussions with ENP and FWS has indicated that FWS/ENP position is that there is sufficient information currently available and that a flow test is not needed to further investigate the western flows. Based on these discussions, the Corps is no longer pursuing completion of the tracer test. Instead, a feasibility study is being recommended for the L-28 Basin.

4.3.1.5.3. <u>L-28 Borrow Canal</u>

The Corps' ERTP-2016 BA states that they will prepare an assessment, using an interagency team, of potential effects of L-28 Borrow Canal flows into western CSSS-A habitat during the Western Basin Restoration Project which is scheduled to begin in August 2016. Results from this assessment could be used to recommend further action; however, the Corps has not yet determined what authority might be required for such action. Potential options under consideration include partial or complete backfill of the borrow canal and is expected to provide benefits to BCNP. Any planning effort will require a multi-agency team to include the Service, BCNP, ENP and FWC, FDEP and SFWMD at a minimum along with consultation with the Miccosukee Tribe of Indians of Florida and Seminole Tribe of Florida. Any proposed actions resulting from this assessment and planning effort will be addressed through separate ESA consultation with the Service and any effects on snail kites will be evaluated within a future consultation.

4.3.1.6. ***Periodic Scientist Calls***

Our 2010 evaluation noted that the recession rates and stage differences discussed above could potentially be improved using real time water management operations and incorporation of WCA-3A Periodic Scientist Call recommendations. The SFWMM did not contain the ability to model flexibility and adaptive management and thus simply provided a baseline indicator of recession rates. In order to meet the WCA-3A Periodic Scientist Call recommended recession rates for any given period, the Corps intended to utilize the operational flexibility inherent within ERTP to achieve the recommendation. For example, Zone E1 contains the flexibility to make up to maximum releases; however, the Corps may make less than the maximum release in order to achieve the WCA-3A Periodic Scientist Call recommendation. This strategy epitomized the ERTP paradigm shift in which operational flexibility and adaptive management would be employed to better meet the needs of multiple species that depend upon WCA-3A. The Periodic Scientist Calls continue to be beneficial for sharing real-time information and for the Service to provide input and recommendations to other stakeholders.

4.3.2. Indirect Effects

Indirect effects are those that are caused by or result from the action, are later in time, and are reasonably certain to occur. The indirect effect evaluated by the Service was the potential increased nutrient loading into ENP by a redistribution of flows through the S-333 and S-12 structures that could result in habitat changes (increased plant growth). Increased phosphorus loading is occurring through the WCAs and into ENP. This potential indirect effect on snail kites and snail kite critical habitat was explored during the 2010 ERTP Biological Opinion through initial water quality analyses. Two suites of technical analyses on the potential water quality implications of ERTP were presented on October 19, 2010, to the Technical Oversight Committee, an interagency body composed of technical representatives of the primary settling parties of the 1992 Federal Consent Decree (Case No. 88-1886-CIV-MORENO). The Corps' draft water quality analysis (Shafer 2010) involved several analytical approaches to better understand potential water quality impacts. General conclusions from Shafer (2010) were that there may be a slight increase in phosphorus concentrations entering Shark River Slough, and that there may be up to a 7 percent increase in nutrient loading through the S-12 structures.

The duration of this action is expected to last until implementation of the Combined Operational Plan (COP) currently scheduled for early 2020. This action will redistribute the location and timing of these flows; and therefore, has the capacity to alter the loading patterns. This may increase plant growth in new areas or possibly beneficially reduce nutrient loading in other areas. Increased plant growth may eliminate suitable foraging areas, but may also provide more nesting substrate (*i.e.*, cattails). Additionally, long-term water quality conditions and trends in the Everglades Protection Area and the long-term flow-weighted mean total phosphorus concentration for inflow structures to ENP continue on an improving downward trend (Martin 2014). Until additional data are collected or new flow patterns occur (with attendant water quality monitoring) the Service cannot assess the magnitude of this indirect effect on the snail kite.

4.3.3. Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The Service has addressed all interrelated and interdependent actions in the analysis of effects above. Therefore, there are no interdependent or interrelated actions associated with the proposed action, that have not already been analyzed under the effects of the action, that are expected to affect Everglade snail kites or their designated critical habitat.

4.3.4. Summary of Effects of the Action

Major components of ERTP that were expected to affect the snail kite and its designated critical habitat included modifications of the WCA-3A Interim Regulation Schedule and removal of the S-12C IOP closure dates. ERTP modeling results suggested that, for both time periods under consideration, ERTP operations would result in somewhat lower water levels during the pre-breeding season (January) when compared to IOP. ERTP was evaluated for three different criteria: prolonged high water, low water, and recession rates.

Since ERTP was implemented in October 2012, 3AVG maximum stage has averaged 11.1 ft NGVD, ranging from a high of 11.6 ft NGVD in 2013, to a low of 10.6 ft. NGVD in 2015. In our 2010 BO, the Service identified a wet season (June 1 – December 31) high water incidental take exceedance criteria as follows: stage above 10.5 ft NGVD at gauge 3AS3W1 for 60 consecutive days in two consecutive years as a result of ERTP operations (or continued IOP operations, prior to ERTP implementation). Under the implementation of ERTP, water levels exceeded this threshold stage once, rising above 10.5 ft NGVD at gauge 3AS3W1 for 70 consecutive days from July 23-September 30, 2013. However, as was observed in 2016, ERTP operations are too limited to affect meaningful reductions in WCA-3A high water levels.

ERTP evaluation criteria for low water concerns focused on dry season water levels for snail kites (PM-B) and apple snails (PM-C). Actual conditions under ERTP since October 2012 have been at least as good as anticipated, and possibly somewhat better in relation to target dry season water levels for apple snails. However, since the 2010 ERTP BO, Florida experienced a 2-year drought (2010-2012). The Service recognized this risk in our 2012 ERTP BO amendment and recommended using caution with the continuation of the ERTP schedule. The current ERTP still lacks the needed flexibility to retain water during drought years – such an improvement will be required in future operational plans in order to realize the needed improvements to kite nesting conditions in WCA-3A.

The dry season recession requirement (for January 1 to May 31) under ERTP was not to exceed 1.7 ft for two consecutive years. The Corps met this requirement from 2012 to 2015. Additionally, the dry season 30-day rolling average recession requirement was to not exceed 0.34 ft for two consecutive years. The Corps has not met this requirement since the implementation of ERTP. The exceedance of the 30-day rolling average recession rate performance measure may be due to seepage (ground water reduction or removal from outside of the WCA areas), because it does not appear to be a simple function of surface water in or out of the conservation areas. The current ERTP still lacks the needed information to assess why this performance measure has not been met, and it is recommended that the Corps evaluate these drastic recessions with the continuation of the ERTP schedule.

4.4. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological 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 Act.

Most of the wetlands within the Action Area for the Everglade snail kite are subject to Corps' jurisdiction and permitting under Section 404 of the CWA. In some instances, wetlands may be determined to be outside the Corps' jurisdiction. For an unknown percentage of these Federal exemptions, it is expected that the State, or county if delegated wetland permitting by the State, will claim jurisdiction and require the process of minimization of, and compensation for, wetland impacts, which should assist in minimizing impacts.

Lands surrounding or adjacent to wetlands used by the snail kite that do not require Federal involvement are where the majority of the cumulative effects are likely to occur. These lands may be developed resulting in disturbance, habitat degradation, reduction in prey availability, isolated hydrologic changes, or permanent habitat loss. Land management activities conducted by State agencies may also have detrimental impacts to these species.

Some wetlands and the areas adjacent to those and other wetlands may be adversely affected by actions without Federal involvement, resulting in a decrease in habitat quality and quantity, prey availability, and productivity for snail kites. However, based on the status of the species discussed previously and the status of the species in the Action Area, we believe that this loss and reduction is not expected to affect the recovery or survival of the snail kite.

4.5. CONCLUSION

ERTP and ERTP-2016 operations pose fewer impacts to the snail kite, apple snail, and their habitat than those experienced under IOP. The modifications incorporated under ERTP and the WCA-3A Regulation Schedule were designed to reduce water levels within WCA-3A, avoid extreme high and low water conditions, and provide for a more gradual, and thus favorable, recession rate during the snail kite's breeding season. However, these potential improvements have not been sufficient to prevent continued habitat degradation or to entirely eliminate negative impacts to snail kite and apple snail productivity in all years. Thus, ERTP-2016 operations are expected to result in continued habitat degradation within WCA-3A, which has been one of the most significant areas of kite habitat within the past 30 years. In addition, ERTP-2016 operations may result in reduced nest success of kites within WCA-3A, reduced foraging habitat suitability, and reduced abundance of the kite's primary prey. These impacts may limit population growth in WCA-3A and possibly cause further reductions in the overall kite population. The impacts from continued implementation of ERTP will be moderated using the operational flexibility informed by adaptive management strategies identified through the periodic scientist calls. Because snail kites are long-lived, have high rates of adult survival, and continue to successfully nest in other portions of their range in southern Florida, these impacts are not anticipated to appreciably reduce the likelihood of survival and recovery of the species in the wild during the next 5 years. Degradation of designated critical habitat within WCA-3A may continue under ERTP-2016 in some years, but this is reversible with improved hydrologic conditions which are anticipated after full implementation of the COP. No permanent loss of critical habitat is expected.

5. EVERGLADE SNAIL KITE CRITICAL HABITAT

5.1. STATUS OF THE CRITICAL HABITAT

This section summarizes the effects of all past human and natural activities or events that have led to the current status of designated critical habitat for the Everglade snail kite and are relevant to formulating the biological opinion about the proposed action.

5.1.1. Critical Habitat Description and Status

Approximately 841,635 acres (Figure 34) was designated as critical habitat for the snail kite in 1977 (50 CFR 17.95). Because this designation was one of the earliest under the Act, specific physical or biological features that are needed by the species were not defined. The designation identified nine critical habitat units (Table 24) that included two small reservoirs, a portion of the littoral zone of Lake Okeechobee, and areas of the Everglades' marshes within the WCAs and ENP. Since this designation, the utilization of these critical habitat units by snail kites as productive nesting areas has varied significantly. Since 2007, the KCOL has supported a large number, and in some year the majority, of nesting snail kites in Florida. This shift in productive nesting areas was in response to regional droughts as well as habitat degradation in historic breeding locations. While the KCOL is now considered an important habitat for the snail kite, this was not the case when critical habitat was designated in 1977, and the KCOL was not included in the original designation. Additionally, large numbers of snail kites now nest within the STAs, particularly STA-5 which accounted for approximately 32 percent of successful snail kite nests and 35 percent of fledglings produced in 2014. The STAs are not designated as critical habitat for the snail kite.

5.1.2. Factors Affecting Critical Habitat

The factors affecting designated snail kite critical habitat are generally the same as those described in the Environmental Baseline of this BO. Therefore, that information is incorporated here by reference. In general, habitat degradation, occurs due to prolonged high water conditions and increased hydroperiods, and is manifested as a loss of woody vegetation and conversion of wet prairies (in WCAs) or marshes (in Lake Okeechobee, St Johns) to open, deeper water wetlands. High water levels and extended hydroperiods have resulted in vegetation shifts, degrading snail kite habitat. In addition to deeper water conditions, hydroperiods in have increased, lengthening the time between drying events and further contributing to the conversion of wet prairie or marsh to less suitable habitat.

Since designation of critical habitat, the Service has consulted on the loss of 18.66 acres of critical habitat for the construction of C&SF Project infrastructure. A Biological Opinion, dated September 12, 2006, addressed the effects of construction of the Miccosukee Tribe's Government Complex Center, which resulted in the loss of 16.88 acres of critical habitat. In addition, the Service has consulted on impacts to 88,000 acres of critical habitat resulting from prolonged flooding and temporary degradation of critical habitat because of prescribed fire. Additional degradation of snail kite critical habitat has occurred because of the effects of long-term hydrologic management, natural climatic events, and eutrophication.

5.2. ENVIRONMENTAL BASELINE

5.2.1. Status of the Critical Habitat within the Action Area

The information in the *Status of the Species* section regarding the status of critical habitat within the action area is incorporated here by reference. The Service does not anticipate critical habitat outside of WCA-3A or ENP would be affected by this project. The previous loss of suitable snail kite foraging and nesting areas within WCA-3A (in both designated critical habitat and other habitat used by snail kites) have been attributed to shifts in water management regimes, and precipitation (including potential habitat degradation due to hurricanes).

WCA-3A, once an important snail kite foraging and nesting area, fledged no young in 2001, 2005, 2007, 2008, or 2010. The increased nesting effort observed in both 2013 and 2014, may be an indication that habitat quality is improving (Fletcher et al. 2015). Similarly, snail kite nesting effort in Everglades National Park increased in 2014 as compared to 2013 (Fletcher et al. 2015). No snail kite nesting activity was recorded for 2014 in WCA-2A WCA-2B, or Loxahatchee National Wildlife Refuge. The assumption is the habitat is either unsuitable or not as suitable as in nearby STA-5 (which had 98 active snail kite nests in 2014).

5.2.2. Factors Affecting Critical Habitat within the Action Area

Habitat degradation within the WCA-3A Unit of critical habitat is discussed in detail in the *Threats to the Species* section of this Biological Opinion, and incorporated here by reference. More specifically, prolonged high water conditions and increased hydroperiods (from September into January or beyond, whether resulting from meteorological conditions, water management operations, or a combination of both) have resulted in the loss of woody vegetation, conversion of wet prairies to open water sloughs, and vegetation shifts that degrade critical habitat within WCA-3A (Zweig 2008; Zweig and Kitchens 2008). The increased hydroperiods in WCA-3A have lengthened the time between drying events and further contribute to the conversion of wet prairie.

Similar habitat changes in ENP are likely less evident due to the lack of containment (*i.e.,* levees or embankments) that occurs around WCA-3A. The result is that water cannot "stack" over the ENP Unit of critical habitat to the same extent as is does in WCA-3A. This limits the extent of habitat degradation due to high water, but could result in habitat changes due to low water, especially during droughts. For the effects of low water on kite habitat see *Prolonged Low Water Levels*.

5.3. EFFECTS OF THE ACTION

The geographic extent of critical habitat for the snail kite was published in the Federal Register on September 22, 1977. Had critical habitat been designated for the snail kite in recent years, regulations would have required publication of a Federal Register Notice that, in addition to describing the geographic extent of the critical habitat, would need to provide information on the biological and physical features essential to the conservation of the species. The effects analysis should use the best available scientific and commercial data available to determine and document those characteristics of the designated critical habitat that support the species' conservation.

The Service has described in *Status of the Species* and *Environmental Baseline* of this BO the best available scientific information on factors affecting the species. We have considered the physical and biological features essential to the conservation of snail kites within their critical habitat, with emphasis on that portion of the critical habitat within the WCAs and ENP. Suitable water depths and hydroperiods are needed to support a moderately dense wet prairie or marsh community, with a predominance of spikerush, beakrush, and other herbaceous plants. Wet prairies (with interspersed aquatic sloughs) dominated by *Eleocharis* spp. and *Panicum* sp. are necessary for snail kite foraging, while areas with woody shrubs, such as tree islands, are optimal nesting locations (Kitchens et al. 2002). Water depths and the timing and rate of water recessions in the normally dry spring season must support survival and reproduction of apple snails during most years. Overly dense stands of vegetation, including rooted stands of cattails and floating tussocks of either cattails or other vegetation, are not suitable for the visual foraging technique of the snail kite even if apple snails are abundant in such areas.

Bennetts et al. (1998b) cautioned management agencies that ". . . artificial attempts to create stable habitat by reducing hydrologic variability will be harmful in the long run." That publication cited as evidence the loss of shrubs that are needed as snail kite nesting substrate, attributable to prolonged deep water in southern WCA-3A. The Service believes that in addition to long-term assessment of vegetation change in snail kite critical habitat, a key uncertainty is the rate of recovery of native apple snail populations to a maximum density following severe drying, such as following the 2001 and 2007 to 2008 droughts, including how that density may be affected by the presence of exotic apple snails.

In 2010, the Service predicted that the effects of ERTP were not expected to impact snail kite critical habitat. In addition, the forecasted dry conditions could potentially result in improvements to wet prairie habitat in WCA-3A, which would benefit from water levels at or slightly below ground surface for approximately 4 to 6 weeks. No new information has been presented to change that conclusion.

5.4. CUMULATIVE EFFECTS

A variety of State and local government actions can directly or indirectly affect water volumes and water quality that could, in turn affect the quantity and quality of critical habitat for the snail kite (see Section 3.4 *Cumulative Effects*). To the extent practicable, the Service attempts to track such State and local actions that may affect snail kite critical habitat and provide technical assistance, as appropriate. While these actions are not necessarily subject to the consultation requirements of the Act, the Service often becomes aware of such proposals through a variety of public forums, news reports, or through early inquiries by environmental consultants who request a list of threatened or endangered species that may be present in the project area. In the case of a wetland-dependent species such as the snail kite, any early comments by the Service will normally lead to the opportunity for consultations through the Corps' Section 404 permit process.

Exotic vegetation removal, habitat management, or fire management programs are on-going in designated snail kite critical habitat by FWC, District, FDEP, and some counties. These efforts are targeted at either removing exotic plants or opening up dense areas of cattails with herbicides or mechanical removal. No Corps permit would be required for such beneficial actions; however, the Service is engaged with these agencies to ensure adverse effects to snail kite critical habitat are avoided during plant removal.

General water quality conditions in snail kite critical habitat are likely stable or improving. The adoption of Total Maximum Daily Loads for phosphorus combined with Best Management

Practices upstream of Lake Okeechobee should benefit water quality conditions in critical habitat downstream of the lake. Similarly, the establishment of the phosphorus water quality standard in the Everglades Protection Area should serve to further improve water quality conditions in critical habitat in the WCAs and ENP.

In summary, although cumulative effects on snail kite critical habitat may occur, they would likely be limited in scope, because the larger water development projects which may affect wetlands or water quality and quantity are anticipated to require a Corps permit. Consequently, these actions are subject to section 7 consultation under the Act.

5.5. CONCLUSION

We find that the snail kite critical habitat will remain functional within the action area to serve the intended conservation role for this species. Our analysis indicates that, as a net result, the physical and biological factors necessary for this portion of the snail kite's critical habitat to support conservation of snail kites would remain functional. After reviewing the status of the snail kite critical habitat, the environmental baseline for the action area, and the periodic effects of the proposed action, it is the Service's BO that the ERTP-2016 is not likely to destroy or adversely modify designated critical habitat for the snail kite.

6. WOOD STORK

6.1. STATUS OF THE SPECIES

6.1.1. Legal Status

The United States breeding population of the wood stork (*Mycteria americana*) was first listed under the Act as endangered on February 28, 1984. Recent population estimates indicate the wood stork population has reached its highest level since it was listed as endangered in 1984. Approximately 11,046 wood stork pairs nested within their breeding range in the southeastern United States in 2013, primarily in Georgia, Florida and South Carolina and the number of colonies continues to rise. The U.S. Fish and Wildlife Service upgraded the status for wood storks from endangered to threatened under the Endangered Species Act on July 30, 2014. No critical habitat has been designated for the wood stork.

6.1.2. Species Description

The wood stork is a large, long-legged wading bird, with a head to tail length of 33 to 45 inches and a wingspan of 59 to 65 inches (Coulter et al. 1999). Wood storks are distinguishable in flight as they fly with their neck and legs extended. Their plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. On adults, the rough scaly skin of the head and neck is un-feathered and blackish in color, the legs are dark, the feet are dull pink, and the bill is blackish in color. Immature wood storks (*i.e.*, wood storks up to the age of about three years) have yellowish or straw-colored bills and varying amounts of dusky feathering on the head and neck (Coulter et al. 1999). During courtship and the early nesting season, adults may develop buff or pinkish coloration on the wing linings; fluffy, plume-like under tail coverts; and bright pink toes.

6.1.3. Life History

The wood stork is the only stork that breeds in the United States and is found primarily in the Southeast. Storks typically begin breeding at three to four years of age. Egg laying in wood storks historically began in early October in south Florida and nesting continued into June (Rodgers 1990). In addition, there was a significant north-south temporal difference in clutch initiation with egg laying in central Florida occurring from February to May. However more recently in south Florida wood storks have begun laying eggs in late January and early February (pers. comm. Mark Cook). The wood storks in the northern distribution of their range (Georgia, South Carolina, North Carolina) begin pair formation in early March or April. A single clutch of two to five (average three) eggs are laid per breeding season, but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation between years in the clutch sizes, and clutch size does not appear to be related to longitude, nesting density, or nesting numbers. Clutch size may be more related to habitat conditions at the time of egg-laying. Egg-laying is staggered, and incubation, which lasts about 30 days, begins after the first egg is laid. Therefore, the eggs hatch at different times and the nestlings vary in size (Coulter et al. 1999).

Wood storks produce an average of 1.29 fledglings per nest and 0.42 fledgling per egg. The probability of survival for each egg during the nesting season (egg-laying to fledging) was 46 percent (Rodgers and Schwikert 1997) (Table 25). The greatest loss (30 percent) occurs from egg-laying to hatching. From hatching to nestlings of two weeks of age, nest productivity loss is an additional eight percent. Corresponding losses for the remainder of the nesting cycle are on the average of six percent per two-week increase in age of the nestling (Rodgers and Schwikert 1997). The young fledge in about eight weeks but will stay at the nest for three to four additional weeks while they continue to be fed by the adults.

Adults feed the young by regurgitating whole fish into the bottom of the nest. This occurs at a rate of approximately three to ten times per day. Feedings are more frequent when nestlings are young (Coulter et al. 1999) and are influenced greatly by the distance adults must fly to locate food (*i.e.*, as foraging flight distance increases feeding rate decreases) (Bryan et al. 1995). The total nesting period, from courtship and nest-building through the independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous, and consequently a colony may contain breeding wood storks for a period much longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site following the completion of breeding.

Wood storks feed almost entirely on fish sized anywhere from 1 to 10 inches long (Kahl 1964; Ogden et al. 1976; Coulter 1987), but may occasionally consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions

(Kushlan 1979). Storks typically wade through the water with their beak immersed and open about 2.5 to 3.5 inches. When the wood stork encounters prey within its bill, the mandibles snap shut, the head is raised, and the food swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956; Kahl 1964; Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

During the nesting period, storks are dependent on consistent foraging opportunities in wetlands within about 18.6 miles of the nest site with the greatest energy demands occurring during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 443 pounds of fish, crustaceans, and other prey during the breeding season with 50 percent of the nestlings' food requirement occurring during the middle third of the nestling period (Kahl 1964). It is estimated that about 110 pounds of food are needed to meet the foraging requirements of the adults and nestlings in the first third of the nesting cycle. Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964; Kushlan et al. 1975).

Gawlik (2002) characterized wood storks as "searchers" that employ a foraging strategy of seeking out areas of high density prey and optimal (shallow) water depths. They seem to abandon foraging sites when prey density begins to decrease below a particular efficiency threshold but while prey is still sufficiently available for other wading bird species to forage in large numbers (Gawlik 2002). Wood stork choice of foraging sites was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely due to their lack of experience and the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage effectively (Hylton et al. 2006). In southern Florida, both adult and juvenile storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile storks from southern Florida move beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004, Borkhataria et al. 2006). Some flocks of juvenile storks have also been reported to move well beyond the breeding range of storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Adult and juvenile storks return southward in the late fall and early winter months. In a study employing satellite telemetry, Borkhataria et al. (2006) reported that nearly all storks that had been tagged in the southeastern United States moved into Florida near the beginning of the dry season, including all sub-adult storks that fledged from Florida and Georgia colonies. Adult storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during the annual Christmas bird surveys, suggest that the majority of the southeastern United States population occurs in central and southern Florida. Relative abundance of storks in this region was 10 to 100 times higher than in northern Florida and Georgia (Service 2007a). Because of these general population-level movement patterns during the earlier period of the breeding season in southern Florida, it is apparent that the wetlands upon which nesting storks depend are also heavily used by a large portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and sub-adult storks from throughout the species' range. In addition, these same wetlands support a variety of other wading bird species (Gawlik 2002).

The wood stork life history strategy has been characterized as a "bet-hedging" strategy (Hylton et al. 2006) in which high adult survival rates and the capability of relatively high reproductive output under favorable conditions allow the species to persist during poor conditions and capitalize on favorable environmental conditions. This life-history strategy may be adapted to variable environments (Hylton et al. 2006) such as the wetland systems of southern Florida.

6.1.4. Habitat

Wood stork nesting habitat consists of mangroves as low as 3 feet, cypress as tall as 100 feet , and various other live and dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962; Rodgers et al. 1987; Ogden 1991; Coulter et al. 1999). Wood storks generally occupy the large-diameter trees at a colony site because storks nest often in conjunction with other wading bird species (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of change to nest site hydrology, wood storks may abandon a site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Borkhataria et al. 2004; Crozier and Cook 2004).

Between breeding seasons or while foraging, wood storks roost in trees over dry ground, on levees, or large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002). While the majority of stork nesting occurs within traditional stork rookeries, a handful of new stork nesting colonies are discovered each year (Meyer and Frederick 2004; Brooks and Dean 2008). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Wood storks forage in a wide variety of wetland types within 31 miles of the colony site, where prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987;Bryan and Coulter 1987). However, foraging occurs most frequently within 12.5 miles of the colony (Coulter and Bryan 1993). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available during shifts in seasonal and annual rainfall and surface water patterns to support nutritional changes. Calm water, about 2 to 16 inches deep and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993). Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, seasonally flooded shallow roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993). Generally, storks use wet prairie ponds early in the dry season then shift to slough ponds later in the dry season, thus following water levels as they recede into the ground (Browder 1984).

Several factors affect the suitability of potential foraging habitat for wood storks. Suitable foraging habitats must provide both a sufficient density and biomass of forage fish and other prey, and have vegetation characteristics that allow storks to locate and capture prey. Hydrologic and environmental characteristics have a strong effect on fish density and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida. Areas with longer hydroperiods generally support more and larger fish (Loftus and Eklund 1994; Turner et al. 1999; Trexler et al. 2002). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites also affect fish density and biomass. Within the highly modified environments of southern Florida, fish availability varies with respect to hydrologic and nutrient availability gradients, and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a variety of hydroperiod classes, nutrient conditions, and spatial variability.

6.1.5. Distribution

The wood stork occurs from northern Argentina, eastern Peru and western Ecuador, north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (American Ornithologists Union 1983). Only the population segment that breeds in the southeastern United States is listed as threatened. In the United States, wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910; Bent 1926; Howell 1932; Oberholser 1938; Dusi and Dusi 1968; Cone and Hall 1970; Oberholser and Kincaid 1974). Storks are found year-round throughout their breeding range, except in South Carolina, North Carolina, and Georgia. Most individuals retreat to Florida and South Georgia during midwinter after breeding season dispersal. Currently, wood stork nesting occurs in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks exist in all southern Florida counties, except for Okeechobee County. Additional expansion of the breeding range of wood storks in the southeastern United States has continued, both to the north and to the west along the Gulf Coast (Service 2007a).

6.1.6. Population Dynamics

The United States breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 (49 FR 7332). From the early 1960s, the wood stork population has declined in southern Florida and increased in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The number of nesting pairs in the Everglades and Big Cypress ecosystems (southern Florida) declined from 8,500 pairs in 1961 to 969 pairs in 1995. During the same period, nesting pairs in Georgia increased from 4 to 1,501 and nesting pairs in South Carolina increased from 11 to 829 (Service 1997).

Since being listed under the ESA as threatened in 1984, annual nest counts have increased significantly in south Florida from 1,245 pairs in 1984 to 2,799 pairs in 2014. Annual nest counts have resulted in a relatively constant estimate of approximately 2,700 pairs in north and central Florida during this same time period. From 1991 to 2014 statewide surveys in Florida suggest that the nesting population increased, and, while colonies were declining in size, the overall number of colonies was also increasing (Frederick and Meyer 2008). Florida's nest counts have also shown an increase from 5,647 to 7,216 pairs since listing. Historically, colonies in the south were associated with extensive wetland systems and predictable patterns of prey availability. Ogden et al. (1987) suggested the population shift was the result of deteriorating feeding conditions in south Florida and better nesting success rates in north-central Florida that compound population growth in that area. Further evidence of a general northern breeding range expansion occurred in 2005 when storks were first documented nesting successfully in North Carolina. Wood storks have continued to nest in North Carolina and have increased their nesting pairs to 284 in 2014, from 32 in 2005.

Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony varies from year-to-year based on availability of suitable wetland foraging areas, which can be affected by local rainfall patterns, regional weather patterns, and anthropogenic hydrologic management (Service 1997). A colony site may be vacant in years of drought or unfavorable conditions due to inadequate foraging conditions in the surrounding area (Kahl 1964). Storks may abandon traditional colony nesting sites completely when hydrological changes occur such as removing surface water from beneath the colony trees (Service 1997; Coulter et al. 1999). Nesting failures and colony abandonment may also occur if unseasonable rainfall causes water levels to rise when they are normally receding, thus dispersing rather than concentrating fish prey (Kahl 1964; Service 1997; Coulter et al. 1999).

6.1.7. Threats

The primary cause of the wood stork population decline in the United States was the loss of wetland habitats or loss of wetland function that resulted in reduced prey availability. Dahl (1990) estimates about 38 million acres, or 45.6 percent, of historic wetlands were lost between the 1780s and the 1980s. However, it is important to note wetlands and wetland losses are not evenly distributed in the landscape. 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 located in the Gulf-Atlantic Coastal Plain. These wetlands were strongly preferred by wood storks as nesting habitat. Since the 1970s, wood storks have been observed shifting their nest sites to artificial impoundments or islands created by dredging activities (Ogden 1991). The percentage of nests in artificial habitats in central and north Florida has increased from about 10 percent of all nesting pairs in 1959 to 1960 to 60 to 82 percent between 1976 and 1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper or Australian pine (*Casuarina equisetifolia*). Ogden (1996) suggested the use of these artificial wetlands indicated wood storks were not finding suitable conditions within natural nesting habitat, or they were finding better conditions at the artificial wetlands. The long-term effect of these nesting areas on wood stork populations is unclear.

Ogden and Nesbitt (1979) indicated a reduction in nesting sites was not the cause in the population decline, because the number of nesting sites used from year to year was relatively stable. They suggested loss of an adequate food base was a cause of wood stork declines. Changes in remaining wetland systems in Florida, including drainage and impoundment, may have been a larger problem for wood storks than loss of foraging habitat (Ogden and Nesbitt 1979). Almost any shallow wetland depression where fish become concentrated, through either local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year, but only a small portion of the available wetlands support foraging conditions (high prey density and favorable vegetation structure) that storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and total acreage of wetland types (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and saw grass marshes) occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973 and found these habitat types had been reduced by 35 percent.

The alteration of wetlands and the manipulation of wetland hydroperiods have also reduced the amount of foraging habitat available to wood storks. The decrease in wood storks nesting on Cape Sable was related to the construction of the drainage canals during the 1920s (Kushlan and Frohring 1986). Water level manipulation can aid raccoon predation of wood stork nests when water is kept too low (alligators deter raccoon predation when water levels are high). Artificially high water levels may retard nest tree regeneration since many wetland tree species require periodic droughts to establish seedlings. Water level manipulation may decrease food productivity if the water levels and length of inundation do not match the breeding requirements of forage fish. Dry-downs of wetlands may selectively reduce the abundance of the larger forage fish species that wood storks tend to use, while still supporting smaller prey fish.

6.1.7.1. *Non-native Invasive Species*

The Burmese python, native to South Asia, is now breeding and expanding its range in the greater Everglades ecosystem increasing concerns among land managers about the potential impacts of this invasive snake. More than 1,400 Burmese pythons have been removed from ENP since 2000. Their population numbers are now estimated to be in the thousands in ENP, potentially impacting a wide variety of listed and native species. A growing wild population of pythons has the potential to create a major ecological problem in ENP and threaten successful restoration of the greater Everglades (NRC 2005, Hart et al. 2015).

The rapid and widespread invasion of Burmese pythons is facilitated by aspects of their natural history such as diverse habitat use, broad dietary preferences, long lifespan (15 to 25 years), high reproductive output, and ability to move long distances. Burmese python hatchlings are larger than hatchlings of native species and are less susceptible to predators. These multiple advantages may allow pythons to compete with native snakes and other predators for food, habitat, and space.

Burmese pythons are generalist predators that consume a wide variety of mammal and bird species, as well as other reptiles, amphibians, and fish (Snow et al. 2007). Like other constrictors, the Burmese python seizes prey with its teeth and then wraps its body around the animal and kills it by constriction. Pythons in Florida have consumed prey as large as white-tailed deer (*Odocoileus virginianus*) and adult American alligators (Snow et al. 2007). As Burmese pythons expand their range in south Florida, it becomes increasingly important to learn what they are eating in order to assess their impact on native fauna and to predict what species are at risk. Fourteen species of mammals, five species of birds, and one species of reptile have been found in the stomachs of pythons collected and examined in Florida (Snow et al. 2007). Many bird species have been found in the digestive tracts of Burmese pythons. These include the pied-billed grebe (*Podilymbus podiceps*), limpkin (*Aramus guarauna*), white ibis (*Eudocimus albus*), American coot (*Fulica americana*), house wren (*Troglodytes aedon*), domestic goose (*Anser* spp.), and wood storks. Juveniles of these giant constrictors will climb to remove prey from bird nests and capture perching or sleeping birds. The relative risk of python predation on wood storks is unknown at this time. By preying on native wildlife, and competing with other native predators, pythons have the potential to seriously impact the natural order of south Florida's ecological communities.

6.1.7.2. ***Contaminants***

The role of contaminants in the decline of the wood stork is unclear. Pesticide levels high enough to cause eggshell thinning have been reported in wood storks, but decreased productivity has not yet been linked to contaminants (Ohlendorf et al. 1978; Fleming et al. 1984). Burger et al. (1993) studied heavy metal and selenium levels in wood storks from Florida and Costa Rica. Adult birds generally exhibited higher levels of contaminants than young birds. Burger et al. (1993) attributed this to bioaccumulation in the adults who may be picking up contaminants at the colony nesting site and while foraging at other locations during the non-breeding season. There were higher levels of mercury in young birds from Florida than young birds or adult birds from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. Though Burger et al. (1993) recommended the lead levels in Florida be monitored; they drew no conclusions about the potential health effects of contaminants to wood storks.

6.1.8. Ongoing Conservation Efforts (Recovery)

Reasonable actions believed to be required for the recovery of the wood stork are outlined in the Service's recovery plan (1997). The plan's recovery criteria state that reclassification, from endangered to threatened, could be considered when there are 6,000 nesting pairs and annual regional production is greater than 1.5 chicks per nest/year (both calculated over a 3-year average). Delisting could be considered when there are 10,000 nesting pairs calculated over a 5-year period beginning at the time of reclassification and annual regional production is greater than 1.5 chicks per nest/year (calculated over a 5-year average). As a subset of the 10,000 nesting pairs, a minimum of 2,500 nesting pairs must occur in the Everglades and Big Cypress systems in south Florida. In 2001, the Service reinitiated another 5-year synoptic aerial survey effort for wood stork colonies throughout the southeast range of the species (Service 2003), and surveys have been conducted annually since then. Three-year averages calculated from nesting data from 2001 through 2006 indicated that the total nesting population had been consistently above the 6,000 reclassification threshold for nesting pairs. These averages have ranged from about 7,400 to over 8,700 nesting pairs during this time period. The three-year average calculated from nesting data from 2011 through 2013 showed the total nesting population was 9,692 nesting pairs. On July 30, 2014, the wood stork was downlisted to threatened.

6.1.8.1. *Wood Stork Nesting in the Southeastern United States*

The wood stork population is increasing and expanding its overall and breeding range in the southeastern United States (Brooks and Dean 2008). The wood stork population has exceeded 10,000 nesting pairs in multiple years following the 2006 breeding season but has not entirely met recovery goals (Table 26). The previous period that the nesting population surpassed 10,000 pairs was in the early 1960s. Wood stork nesting continues to be recorded in North Carolina after it was first documented there in 2005. This suggests that the northward expansion of wood stork nesting may be continuing. The number of colonies also continues to rise with over 100 nesting colonies reported in 2014 throughout the southeastern United States, which is the highest to date in any 1 year (Brooks and Dean 2008).

6.1.8.2. *Wood Stork Nesting in the Everglades and Big Cypress Systems*

The number of nesting pairs in south Florida's Everglades and Big Cypress ecosystems declined from 8,500 pairs in 1961 to fewer than 500 pairs from 1987 through 1995 (Service 2007a).

The *South Florida Multi Species Recovery Plan* (Service 1999) defines the Everglades and Big Cypress ecosystems as the area south of Lake Okeechobee from Lee County on the west coast to Palm Beach County on the east coast. Total nesting pairs for colonies in this region have varied from year to year. In a review of nesting data for the Everglades and Big Cypress basin region, wood stork nesting effort has shown a significant increase from 2005 to 2014 with 634 and 2,799 pairs, respectively (Table 27). The highest peak of nesting occurred in 2009 with over 6,000 nesting pairs. These observed fluctuations in nesting between years and nesting sites have been attributed primarily to variable hydrologic conditions during the nesting season

(Note: *Hydrologic condition can be located in the South Florida Wading Bird reports for each breeding season from 1996-2014*). Frequent heavy rains during nesting can cause water levels to rise rapidly. The abrupt increase in water levels (*i.e.*, a "reversal") during nesting may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success have been reported to affect most wading bird colonies in southern Florida (Crozier and Cook 2004; Cook and Call 2005; Cook and Kobza 2008). Optimal foraging conditions in 2006 resulted in high nesting success, but the 2-year drought that followed in 2007 and 2008 resulted in very little nesting success in south Florida (Cook and Call 2006, Cook and Herring 2007, Cook and Kobza 2008). The 2007 to 2008 drought was followed by a year with below average rainfall and no reversals. This resulted in the kind of hydrology that likely accounted for increased nesting success in wood storks for 2009 (Cook and Kobza 2009).

Since 1996, the annual South Florida Wading Bird Report has included a summarization of nesting patterns for wood storks in the Everglades using a set of performance measures meant to capture ecological relationships found in the historical ecosystem. These annual summaries are useful for characterizing pre-CERP nesting patterns. The key parameters are number of nesting pairs, location of nesting colonies, timing of stork nesting, and the occurrence and frequency of wood stork "super colonies". The Service has set different recovery goals for wood storks in south Florida than those set for CERP. The Service goals include a running average of 2,500 nesting pairs per year and a nest production that averages at least 1.5 young per active nest.

6.2. ENVIRONMENTAL BASELINE

6.2.1. Status of the Species within the Action Area

Since 1986, the Corps has funded a program to monitor nesting effort and success of wading birds, including wood storks, in the WCAs. The objectives are to track the demographics of the various species in an attempt to understand the environmental variables that relate to successful breeding. The program includes aerial surveys that identify locations of wading bird nesting colonies each year and estimate the number of nests produced by each wading bird species. Ground surveys are also conducted in colonies that contain wood storks. The results of these surveys help researchers estimate nesting success (number of young fledged) in a sub-set of marked nests. Nesting effort (number of nests) of wood storks from 2005 to 2014 in the various colonies in the WCAs and just south of WCA-3B in ENP is summarized in Table 28.

The implementation of ERTP began in October 2012. Since being implemented, in 2013 and 2014 there was a 56 percent and 69 percent, respectively, increase above the 10 year average in the number of wood stork nests initiated within WCA-3A. Additional data are needed to discern whether the increase was related to; 1) improved water management operations under ERTP (recession rates/water depths), or 2) the increase in overall abundance of the wood stork breeding population.

In 2012, wood storks did not initiate any nesting activity in the WCAs; however, wood storks did nest within ENP. The 2012 season had above average water levels throughout the system for most of the season. Despite strong recession rates (>60 percent of years in the period of record in either the early or late drying period of 2012) water levels generally remained above average. A strong reversal, due to rain starting in late April, pushed water levels up well above average. High water levels limit nest success by decreasing prey availability. It is believed that most nests failed due to heavy rains that occurred before any young had fledged.

In 2013, 506 nests were initiated in the WCAs, which is 56 percent above the ten year average (Frederick and Vitale 2013). The 2013 nesting season began in November 2012 with relatively high water levels, reasonable wet season hydroperiods, and variable water recession rates during the dry season throughout the system. Water levels remained above average for the majority of the season. A reversal started in mid-April due to rain and pushed water levels up well above average. High water levels during this time of year (dry season) generally limit nest success by decreasing prey availability. Nesting success was variable between colonies and across all nests averaged 2.00 fledglings per successful nest (*i.e.*, a nest in which the young were raised until day 50) (Frederick and Vitale 2013).

In 2014, 497 wood stork nests were initiated in the WCAs, which is 69 percent above the ten year average (Frederick and Vitale 2014). Wood storks nested in two phases in 2014, with the majority of the first phase of nests resulting in failure. The earliest nesting in 2014 occurred in late January in ENP. It is thought that the higher than normal water depths resulting from high rainfall in summer/fall of 2013 led to this delay. Despite the late start, the second phase of nest attempts was largely successful with many nests fledging young, with an average of 1.94 fledglings per successful nest.

In 2015, wood storks did not initiate nesting at any of the colonies within the WCAs. However, 75 nests were initiated within ENP at the Tamiami West colony. During wading bird colony surveys on May 7th, shortly after widespread storms and water-level reversals on April 29, it was apparent that wood stork nests had been abandoned at multiple colonies. However, Tamiami West wood stork nests appeared to be unaffected, with attending adults and medium- to large-sized chicks present.

6.2.2. Factors Affecting the Species Environment within the Action Area

6.2.2.1. *Hydrology*

Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over 3 feet during the wet season (June to October), and then receding gradually during the dry season (November to May). Historically, the annual climatological pattern that appeared to stimulate the heaviest nesting efforts by wood storks was a combination of the average or above-average rainfall during the summer rainy season prior to colony formation and an absence of unusually rainy or cold weather during the following winter-spring nesting season (Kahl 1964). This pattern produced widespread and prolonged flooding of summer marshes that maximized production of freshwater fishes, followed by steady drying that concentrated fish during the dry season when storks nest (Kahl 1964).

Wood storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the wood stork nesting period, any one site may only be suitable for wood stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for wood storks to access the wetlands. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging, and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964; Gawlik 2002).

Researchers (Fleming et al. 1994; Ceilley and Bortone 2000) acknowledge that the short hydroperiod wetlands provide a more important pre-nesting food source and a greater effect on early nestling survival for wood storks than the foraging base (ounces of fish per square foot) that is suggested in short hydroperiod wetlands. For instance, Loftus and Eklund (1994) provide an estimate of 5 fish per square foot for long hydroperiod wetlands and 0.5 fish per square-foot for short hydroperiod wetlands. Because of the consistent pattern of drying that normally occurs during the wood stork nesting season, the short hydroperiod wetlands would also be the areas used for foraging early in the season when long hydroperiod wetlands remain too deep for wood storks to forage effectively, or sufficient prey concentration has not yet occurred because of drying.

Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for wood storks during colony establishment, courtship and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.*, 30 and 8 percent, respectively, from egg-laying to hatching and from hatching to nestling survival to 2 weeks) (Rodgers and Schwikert 1997).

Considering the relatively low foraging values these short hydroperiod wetlands provide in relation to corresponding long hydroperiod wetlands, a much larger proportion of long hydroperiod wetlands are needed to ensure survival and to sustain development of nestlings. The disproportionate reduction (85 percent) of long hydroperiod wetlands known to have occurred from development and overdrainage has been postulated as a major cause of late colony formation and a reduction in early nestling survival rates (Fleming et al. 1994).

Within WCA-3A, IOP was expected to result in continued high water levels during the wet season and early dry season, followed by a rapid spring recession and rapidly increasing stages in the early wet season (Service 2002). These effects would result in relatively high abundance of wood stork prey because of high stages and long hydroperiods, allowing prey to become available to wood storks at a rapid rate in the late dry season. Because the IOP WCA-3A deviation schedule resulted in an increased rate of recession beginning on February 1, availability of prey to wood storks early in their nesting season prior to February 1 was limited in WCA-3A. The expected effect of this condition was late nesting initiation and/or reduced rates of nest initiation in those colonies closely associated with WCA-3A (*i.e.*, L-28 Crossover, Jetport, and others). Within the vicinity of western ENP and lower SRS, IOP was expected to result in early recession rates within the short-hydroperiod marshes south of Tamiami Trail resulting from the closures of the S-12 and S-343 structures. This resulted in early initiation of nesting within these areas, but the limited water deliveries into SRS in the dry season may have resulted in reduced amounts of potential foraging habitat for colonies closely associated with this region, especially during dry years.

Modeling indicated that IOP occasionally resulted in increased water levels in NESRS during the spring dry season. These conditions presumably occurred when stages were sufficiently low that the G-3273 constraint did not restrict inflows, and water from WCA-3A was diverted into NESRS through the S-333 structure. In these cases, water levels within NESRS, in the immediate vicinity of the Tamiami West stork colony, would rise by up to 1 ft during the period when storks were nesting and when water levels were generally receding throughout the system. This type of action produces an artificial reversal and can cause a reduction in stork foraging conditions in areas near the colony, and may be significant enough to cause colony abandonment. Because the foraging radius of the Tamiami West colony includes parts of WCA-3A, WCA-3B, ENP, the Pennsuco Wetlands, and urban areas, sufficient foraging opportunities remained in other areas to offset the poor foraging conditions that resulted from IOP in NESRS, but some reduction in foraging opportunities were expected.

6.2.2.2. ***Invasive and Exotic Species***

Invasive and exotic species may also affect wood storks. Invasive plant species such as *Melaleuca*, Australian pine, Brazilian pepper, and other woody species can become established in wood stork habitat and reduce habitat suitability, although wood storks are known to use such habitat, it is considered of lower quality than native habitats (Service 2007a). The potential expansion of dense stands of cattail due to high phosphorus may also reduce wood stork foraging habitat. Dense submergent and emergent vegetation may reduce foraging suitability by preventing wood storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993).

Limited information is available on the effects of invasive exotic animals on wood storks. Species like the Burmese python have become established in wood stork habitat, and telemetry data collected in the southern Everglades suggests the large constrictors are attracted to wading bird colonies. There has been one documented case of a python consuming a juvenile wood stork. In 2013 and 2014 camera traps revealed pythons were moving towards initiating colonies and even have been found in empty nests. However there was no recorded activity of pythons predating on wading birds throughout the study, and this may be due to the cryptic behavior of the species (Frederick and Vitale 2013, 2014).

6.2.2.3. *Water Quality*

The Everglades were historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions of the Everglades have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern, because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species that reduce the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey.

6.2.2.4. *Climate Change*

Climate change represents significant short and long term threats to the environmental baseline of the wood stork and their habitat (Appendix D). Surface temperatures and evapotranspiration are expected to increase which will likely adversely increase recession rates during the wood stork foraging and breeding season. Rainfall patterns are expected to change with more rain in the fall and winter months and less rain during the spring and summer months. Changes in rainfall patterns can create changes in breeding and foraging behavior.

The Service will continue to monitor this situation closely and will implement Strategic Habitat Conservation Planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006b).

6.2.2.5. *El Nino*

Wetter than average conditions due to the very strong El Nino effects prevailed in South Florida through the first half of 2016, encompassing the 2016 wood stork breeding season (Figure 18). These El Nino events have a significant effect with higher water levels and deeper water depths in the core foraging areas. The occurrence of El Nino conditions resulted in a major short term negative effect on the environmental baseline for wood storks ability to forage and fledge their young in 2016 because of the wetter conditions. It is likely that wood storks started to be effected by El Nino in early February when reported observations of dead and dying storks where showing up in southwest Florida and ENP. By mid-March there was some nesting occurring in south Florida at three colony sites (Paurotis Pond, Broad River, and Cabbage Bay). Within WCA-3A there were poor conditions for foraging and nesting. As the 2016, wet season approached recommendations for water management were made to discourage wood stork nesting in the WCA-3A due to the low probability of a breeding colony being able to fledge young.

6.2.3. Summary of Environmental Baseline

Wood Storks nest during the dry season and are dependent on drying wetlands as an environmental cue for nest initiation. The reduction of long hydroperiod wetlands known to have occurred from development and overdrainage has been postulated as a major cause of late colony formation and a reduction in early nestling survival rates (Fleming et al. 1994). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for wood stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for wood storks to access the wetlands. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern, because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species reducing the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey. Furthermore, an invasive exotic animal such as the Burmese python can affect the success of wood storks during the breeding season.

6.3. EFFECTS OF THE ACTION

This section addresses the direct and indirect effects of the Action to the wood stork, including the effects of interrelated and interdependent activities. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

6.3.1. Factors to be considered

The components of ERTP-2016 that may affect the wood stork and other wading bird species include the WCA-3A Interim Regulation Schedule and the seasonal closure dates on the S-12C structure. The other components of ERTP-2016 (*i.e.*, Rainfall Plan Target Flows, S-346 and S-332D operations, etc.) will have little effect on the wood stork. In addition, the WCA-3A PSC will continue to provide a mechanism to evaluate hydrological and ecological conditions within wood stork habitat to allow for adaptive management of the system to protect the needs of multiple species, including the wood stork and other wading bird species.

The modification of the WCA-3A Interim Regulation Schedule and removal of the S-12C closure dates were designed to aid in reducing high water levels within WCA-3A and to address human health and safety concerns (Corps 2010a). Through these modifications, the Corps has additional flexibility in releasing water from WCA-3A in order to: (1) better manage recession and ascension rates, (2) alleviate high water conditions, and (3) provide beneficial effects to the wood stork and its habitat.

The Service has identified changes in hydrology, invasive and exotic species, and water quality as the factors potentially affecting the wood stork within the action area as a result of the implementation of ERTP-2016. The proposed action involves the continuation of ERTP, which was implemented starting in WY 2013, and the effects discussed below are based on an analysis of conditions observed within the action area since that time. In addition, the Service anticipates future effects to the wood stork as a result of the proposed action will be similar to those documented within the action area since 2013. Due to limited information on the effects of invasive and exotic species and water quality on wood storks, our analysis focuses on the hydrological variables most closely associated with wood stork foraging behavior and nesting success.

6.3.2. Analysis for Effects of the Action

Water depth and recession rate are the two most important hydrological variables for wood storks (Gawlik et al. 2004). To have a successful nesting year, wood storks must have access to suitable habitat throughout the dry season, but the location of the suitable habitat can vary across the landscape. Gawlik et al. (2004) developed a wood stork suitability index based solely on the physical processes that concentrate aquatic prey and make them vulnerable to capture by wood storks. The index was calculated from SFWMM and NSM output for the 2-mile by 2-mile grid cells in the remnant Everglades. At any one time, a highly suitable landscape will likely consist of cells that have not yet reached their peak suitability for the year, cells that have already passed their peak suitability, and cells that are at their highest suitability. According to Gawlik et al.'s (2004) habitat suitability index for wood storks, 23 percent of a core foraging area is occupied at any one time by feeding wood storks during a good nesting year.

In 2010, wood stork-related water management recommendations for ERTP were developed by James Beerens and Dr. Mark Cook of the District. Using average daily stage data in WCA-3A and foraging flock observational data from 2000 to 2005, Beerens and Cook (2010) identified water levels (stages) that provide foraging habitat at the start (January 1) and at the end (May 31) of the breeding season and determined the minimum and maximum water depths for foraging according to the average of the following gauges in WCA-3A: 3A-3, 3A-4, and 3A-28 (3AVG). In addition, they used presence-absence observations of foraging wood storks from systematic reconnaissance flights conducted during 2000-2009 in conjunction with mean used water depth and recession rate data (estimated using Everglades Depth Estimation Network [EDEN] and calculated using SAS version 9.3 software [SAS Institute 2003]) to determine the optimal recession rate and site-specific optimal water depths used by wood storks over a 10 year period. This recession rate was then applied to the 3AVG water levels to determine lower and upper thresholds at the start and end of the breeding season, respectively. The resulting range of water levels encompasses short hydroperiod areas in northwest WCA-3A (available early in the season) to longer hydroperiod areas in southeast WCA-3A (which become available later in the season).

The implementation of ERTP was meant to provide the ability to better manage WCA-3A for multiple species including the wood stork. The Corps and Service, in conjunction with the multi-agency ERTP team, developed performance measures (PMs) and ecological targets (ETs) for each species and their habitats. PMs and ETs contained within ERTP incorporated recommendations found within the Service's Multi-Species Transition Strategy (MSTS) for WCA-3A which was specifically designed to identify water depths and stages within WCA-3A to benefit species and the habitats on which they rely (Citation for MSTS). The inclusion of these recommendations into ERTP represented a significant improvement over IOP operations. Specifically, PMs were defined as a set of operational rules that identify optimal WCA-3A water stages and recession rates to improve conditions in WCA-3A for the snail kite, wood stork, wading birds and tree islands. The two PMs developed specifically for wood storks were:

- (PM-F) - WCA-3A (Dry Season Recession Rate): Strive to maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1.
- (PM-G) - WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (CFA) (18.6 mile radius) of any active wood stork colony.

6.3.2.1. ***Recession Rate***

A recession rate of 0.07 ft per week (1.89 cm per week), with an optimal range of 0.06 to 0.07 ft per week (1.82 to 2.03 cm per week), is recommended from January 1 to May 31 to provide foraging opportunities for breeding wood storks. Based on their analysis of recession rates used by foraging wood storks during the 2000 to 2009 dry seasons, Beerens and Cook (2010) further described recession rates as follows: the "suboptimal rapid" category included rates from 0.07 to 0.17 ft per week (2.03 to 5.11 cm per week); the "too rapid" category included rates from 0.17 to 0.37 ft per week (5.11 to 11.34 cm per week); the "suboptimal slow" category included rates from -0.05 to 0.06 ft per week (-1.40 to 1.82 cm per week); and the "reversal" category included rates from -0.05 to -0.23 ft per week (-1.40 to -7.00 cm per week). Recession rates greater than 0.37 ft per week (11.34 cm per week) and reversals greater than -0.23 ft per week (-7.00 cm per week) were considered too rapid to support wood stork foraging. [Note that negative values indicate increasing water levels (*i.e.*, reversals)]

The optimal recession rate of 0.07 ft per week was used to back-calculate from the minimum stage associated with stork use of 8.02 ft (Figure 35) to the beginning of the breeding season on January 1. This calculation corresponded to a stage of 9.5 ft (Figure 35). This same recession rate was applied forward from the maximum stage (10.37 ft) associated with wood stork use of WCA-3A (Figure 35) and resulted in a value of 8.86 ft at the end of the breeding season on May 31. These two lines represent the ideal range of the 3AVG that provides wood stork foraging in WCA-3A throughout the course of the breeding season.

Under the current WCA-3A Interim Regulation Schedule, recession rates have been too rapid in many years to support successful snail kite nesting and foraging; however, wood storks and other wading birds require a more rapid recession rate to concentrate their prey items into shallow pools for more effective foraging. Conversely, too rapid drying conditions, if repeated year after year, would soon reduce the prey base required for successful breeding (Fleming et al. 1994).

ERTP-2016 attempts to avoid recession rates that are unfavorable to wood storks and other wading birds by including a recommended range of recession rates targets (PM-F). The ERTP recommended recession rate for wood storks and other wading birds was 0.06 to 0.07 ft per week from January 1 to June 1. The recession rate for any given week or period of time was determined based upon recommendations made during the WCA-3A PSC. Results from the SFWMM were evaluated for recession rate and suggested an improvement in recession rates under ERTP implementation. However, it is important to note that the recession rates can be improved using real time water management operations and incorporation of WCA-3A PSC recommendations. Implementation of the ERTP WCA-3A Interim Regulation Schedule was expected to produce a mosaic of wetland habitats within WCA-3A that would provide favorable foraging opportunities for wood storks. In addition, the incorporation of foraging depth requirements (PM-G) into ERTP addressed wood stork foraging particularly within the highly important marshes of their core foraging area during the breeding season.

6.3.2.2. *Water Depth*

Water levels between 9.5 and 10.37 ft NGVD on January 1 were recommended to provide favorable conditions for wood stork and other wading birds foraging in WCA-3A. Based on their review of wood stork survey data and hydrological data during 2000-2005, Beerens and Cook (2010) found that the maximum 3AVG stage associated with wood storks feeding in WCA-3A (beginning in the northwest) was approximately 10.37 ft (Figure 35). Their analysis also indicates that wood storks used a mean depth of 0.48 ft (14.63 cm), with the optimal range including the 95 percent confidence interval equal to 0.46-0.50 ft (13.93-15.33 cm). Beerens and Cook (2010) further described high water foraging depths as follows: the "suboptimal wet" category included depths from 0.50 ft (15.33 cm) up to 1.35 ft (41.26 cm); the "too wet" category included depths from 1.35 ft (41.26 cm) up to 2.09 ft (63.67 cm); depths greater than 2.09 ft (63.67 cm) were considered too wet for stork feeding.

Beerens and Cook (2010) also determined minimum water levels between 8.00 and 8.86 ft NGVD would provide favorable conditions for wood stork and other wading bird foraging in WCA-3A. Based on their review of wood stork survey data and hydrological data during 2000 to 2005, Beerens and Cook (2010) found that the minimum 3AVG stage associated with wood storks still feeding in southeastern WCA-3A was approximately 8.02 ft (Figure 35). Flock size appeared to increase correspondingly with a decrease in stage during the breeding seasons in these years. In addition to their categorization of high water foraging depths, Beerens and Cook (2010) further described low water foraging depths as follows: the "suboptimal dry" category included depths from 0.46 ft (13.93 cm) down to -0.31 ft (-9.33 cm); the "too dry" category included depths from -0.31 ft (-9.33 cm) down to -1.63 ft (-49.66 cm); depths less than -1.63 ft (-49.66 cm) were considered too dry for feeding. [Note that negative depths indicate water levels below ground surface based on the 3AVG ground elevation - at such levels there may be water in the southern end of WCA-3A and in deeper pockets throughout the conservation area.]

6.3.3. Direct effects

Direct effects are those effects that are caused by the proposed action at the time of implementation and are reasonable certain to occur. For this action, direct effects include the impacts to wood stork foraging habitat as a result of recession rate and water depth. Without the supply of concentrated prey that results from dry season recessions, adult wood storks are unable to support their offspring. The Service used two performance measures to interpret the potential direct effects to the wood stork from the proposed action; 1) the goal of maintaining a recession rate of 0.07 feet per week from January 1 to June 1 (PM-F), and 2) the goal of maintaining areas of appropriate foraging depths between 5 and 25 cm within the CFA of any active wood stork colony (PM-G).

6.3.3.1. ***Recession rate (PM-F)***

Observed weekly recession rates during the three breeding seasons (2013, 2014, and 2015) in which water management operations were as described within ERTP are illustrated in Tables 29, 30, and 31. During WY 2013, WY 2014, and WY 2015, recession rates for wood storks were mostly observed within the "suboptimal" category, either slow or rapid. This occurred in 16 of 22 (76 percent) weeks during 2013, 15 of 22 (68 percent) weeks during 2014, and 17 of 22 (77 percent) weeks in 2015 (Corps 2013, 2014, 2015). Reversals were also experienced during each of the three water years. In 2013, the "reversal" category was observed in early May with a reversal that was too rapid to support wood stork foraging (0.28 feet per week) occurring during the week prior to May 5, 2013. In 2014, the "reversal" category was observed during early February and late May with a reversal (0.10 feet per week) occurring during the week prior to June 2, 2014. In 2015, the "reversal" category was observed only once (0.08 feet per week) during the week prior to April 29, 2015. Recession rates within what is considered the "optimal" range only occurred in 5 of 22 (23 percent) weeks in 2013, 5 of 22 (23 percent) weeks in 2014, and 4 of 22 (18 percent) weeks in 2015 (Corps 2013, 2014, 2015).

The Corps conducted retrospective reviews in 2013, 2014, and 2015 to determine the potential cause(s) of recession rates outside the preferred range experienced during each of the respective dry seasons (*i.e.* January 1 through June 1) and how future operations could avoid exceeding these thresholds. The Corps concluded that WCA-3A outlet structures were opened and closed as per the WCA-3A regulation schedule and rapid recession rates during the dry season were attributed to evapotranspiration rates. However, there may be some additional opportunities to use operational flexibility and preemptive releases in particular to assist in attaining recession rates within the preferred range for wood storks.

6.3.3.2. ***Foraging depths (PM-G)***

In 2013, suitable water depths (optimal/sub-optimal) for wood stork foraging within WCA-3A were available throughout much of the wood stork nesting season at Gauge 3A-3 and 3ASW (Figure 36). However, undesirable water depths at Gauge 3A-3 and 3ASW occurred between October and December 2012 and after mid-June. Appropriate foraging depths were experienced between March and June at Gauge 3A-4 and were not attained at Gauge 3A-28 in southern WCA-3A during WY13. In WCA-3B, water depths at Gauge 3B-2 were appropriate for wood stork foraging throughout much of WY13, with the exception of periods during October through December 2012 and mid-July through September 2013 (Figure 37). Depths experienced at Gauge 3BS1W1 were deeper than those required to support foraging wood storks throughout much of WY13 with the exception of mid-February through late May 2013. As shown in Table 29, two reversals occurred due to rainfall events during the week ending April 21, 2013 and again during the week ending May 5, 2013. Between December 2012 and March 2013, suitable foraging depths were available in the area around Gauge 3A-3 and Gauge 3ASW, after which time, water depths dropped below suitable levels.

In 2014, suitable water depths (optimal/sub-optimal) for wood stork foraging within WCA-3A were available throughout much of the wood stork nesting season at Gauge 3A-3, 3A-4 and 3A-SW (Figure 38). Appropriate foraging depths were experienced between late November 2013 and September 2014 at Gauge 3A-3, November 2013 through late April 2014 at 3A-SW, February and August 2014 at Gauge 3A-4 and April and August 2014 at Gauge 3A-28 in southern WCA-3A. However, undesirable water depths at Gauge 3ASW occurred between May and mid-July 2014 and also at Gauge 3A-28 between October 2013 and mid-April 2014. In WCA-3B, water depths at Gauge 3B-2 were appropriate for wood stork foraging between March and August 2014 (Figure 39). Depths experienced at Gauge 3BS1W1 were deeper than those required to support foraging wood storks throughout much of WY14 with the exception of April through late June 2014. A reversal occurred during the week ending February 3, 2014 and again during the week ending June 2, 2014, signaling the onset of the rainy season (Table 30).

In 2015, suitable water depths (optimal/sub-optimal) for wood stork foraging within WCA-3A were available throughout much of the wood stork nesting season at Gauge 3A-3 and 3A-4 (Figure 40). Appropriate foraging depths were experienced between December 2014 and May 2015 at Gauge 3A-3, February 2015 through September 2015 at 3A-4, March 2015 and May 2015 at Gauge 3A-SW and May 2015 through August 2015 at Gauge 3A-28 in southern WCA-3A. However, undesirable water depths at Gauge 3ASW occurred in April and between June and September 2015 and also at Gauge 3A-3 between April 2015 and August 2015. In WCA-3B, water depths at Gauge 3B-2 were deeper than those required to support foraging wood storks throughout WY15 (Figure 41). Depths experienced at Gauge 3BS1W1 were suitable for foraging wood storks between February 2015 and September 2015 and were too deep for much of the remainder of WY15 (Figure 41).

6.3.4. Indirect effects

Indirect effects are those that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. The duration of the proposed action is expected to last until implementation for the Combined Operational Plan (COP) currently schedule for early 2020. The main indirect effect considered by the Service includes the potential increased nutrient loading into ENP by a redistribution of flows through the S-333 and S-12 structures. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern, because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species that reduce the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey. However, the increased risk of habitat change to the wood stork resulting from the proposed action is difficult to predict and assess.

6.3.5. Interrelated and Interdependent Actions

An interrelated action is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent action is an activity that has no independent utility apart from the action under consultation. The Service has considered and addressed all interrelated and interdependent actions in the analysis of effects above. There are no interrelated or interdependent actions associated with the proposed action that have not already been analyzed under the effects of the action that are expected to affect the wood stork.

6.4. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological 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 Act.

Most of the wetlands within the Action Area for the wood stork are subject to Corps' jurisdiction and permitting under Section 404 of the CWA. In some instances, wetlands may be determined to be outside the Corps' jurisdiction. For an unknown percentage of these Federal exemptions, it is expected that the State, or county if delegated wetland permitting by the State, will claim jurisdiction and require the process of minimization of, and compensation for, wetland impacts, which should assist in minimizing impacts.

Lands surrounding or adjacent to wetlands used by the wood stork that do not require Federal involvement are where the majority of the cumulative effects are likely to occur. These lands may be developed resulting in disturbance, habitat degradation, reduction in prey availability, isolated hydrologic changes, or permanent habitat loss. Land management activities conducted by State agencies may also have detrimental impacts to these species.

Some wetlands and the areas adjacent to those and other wetlands may be adversely affected by actions without Federal involvement, resulting in a decrease in habitat quality and quantity, prey availability, and productivity for wood storks. For evaluation of the cumulative effects, the Service is considering the wood stork action area to include the following counties: Broward, Collier, Miami-Dade, and Monroe.

Our analysis estimates how many acres of wetlands will be affected by non-federal actions in the future by calculating how many acres were affected in the past 5 years, and projecting that loss rate into the future. Thus, dividing 9,813.79 acres by 5 years results in an average of 1,963 acres of wetlands lost per year for this 5-year period (Table 32). However, approximately 500 acres of non-CERP wetland impacts were associated with wetland enhancement or restoration projects in Miami-Dade County during the same time period. The result is a total of 500 acres of wetland impacts which could be considered beneficial to the species based on their purpose as wetland habitat enhancement projects. The remaining 9,313.79 acres of wetlands that were lost to development includes over 6,000 acres of wetlands permitted for rock mining in Miami-Dade County during 2010. This averages out to approximately 1,863 acres per year throughout the four counties listed in Table 32.

Using the average rate of wetland loss, and the assumption that an additional 20 percent of privately-owned wetlands would not be subject to Corps regulatory review, approximately 373 acres of wetlands impacts per year would not require a CWA Section 404 permit. Extrapolating this annual rate of loss forward for the next 5 years would equal 1,865 acres of wetlands potentially filled without Corps regulatory review within the wood stork action area. The core foraging area for the wood stork colonies in the action area is 542,080 acres. Thus, a loss of 1,865 acres equals a spatial loss of 0.3 percent of the core foraging area. This loss of wetland foraging habitat for wood storks may have adverse effects to individual colonies or be expressed

6.5. CONCLUSION

Water depths and recession rates are the two most important evaluation criteria for analyzing any impacts ERTP-2016 may have on wood storks. Since the implementation of ERTP in WY 2013, weekly recession rates within the action area have been within the “suboptimal” category for the majority of the time (*i.e.*, mean of 74 percent of the time during each WY). In 2013, a reversal occurred in early May that was categorized as “too rapid to support wood stork foraging” (0.28 feet per week) while smaller reversals occurred in 2014 (February and May) and 2015 (April). Recession rates within the “optimal” range were observed on average 21 percent of the time during each WY since implementation of ERTP.

Recession rates that are considered “too rapid” have occurred under ERTP operations and some of these operations have resulted in reversals during the onset of the wet season or prior to nest initiation. Reversals occurring early in the dry season reduce foraging opportunities for adult wood storks and delay nest initiation. Wood stork colonies that initiate late during the dry season (February/March) are affected by reversals when trying to fledge nestlings, and concentrated prey becomes unavailable.

Despite long periods of time within the 2013, 2014, and 2015 breeding seasons where foraging depths were unfavorable to wood storks as measured at individual gauges, no obvious correlation between wood stork nesting effort and the foraging depth measured at a particular gauge was apparent in the wading bird monitoring data collected during these years. This is likely due to the availability of suitable water depths (optimal/sub-optimal) throughout much of these wood stork breeding seasons as measured at other gauges throughout the action area. Nesting effort by wood storks was above average within the WCAs in both WY 2013 and WY 2014. However, in WY 2015 there was no nesting activity by wood storks in the WCAs, and the only active wood stork colony within the ERTP action area was located in ENP (Tamiami West).

Wetlands located within the core foraging area of wood stork colonies may be affected by non-federal actions not subject to Service review. The additional loss of these wetlands may result in impacts to wood storks that are expressed in terms of reproductive output or productivity. However, based on our analysis of potential impacts to wetlands not subject to Service review, the loss or reduction of foraging value to the wood storks associated with these systems is not likely to be significant (*i.e.*, 0.3 percent).

Impacts to wood stork foraging and nesting are likely to occur under the continuation of ERTP as a result of reduced foraging habitat suitability and increased potential risk of depredation for some wood stork colonies. These effects are not expected to appreciably reduce the likelihood of survival and recovery of the species in the wild.

After reviewing the status of the wood stork, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the continued implementation of ERTP, as proposed, is not likely to jeopardize the continued existence of the wood stork. No critical habitat has been designated for this species; therefore, none will be affected.

7. REASONABLE AND PRUDENT ALTERNATIVES

A Biological Opinion states the opinion of the Service as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat (50 CFR §402.02). The preceding sections of this BO have evaluated the effects resulting from the Corps' proposed continued operation of the ERTP to the CSSS, snail kite, and wood stork, and to designated critical habitat for the CSSS and snail kite. As proposed, the ERTP-2016 is not likely to jeopardize the continued existence of the snail kite (section 4.5) and the wood stork (section 6.5), or to destroy/adversely modify critical habitat for the CSSS (section 3.5) and the snail kite (section 5.5), but is likely to jeopardize the continued existence of the CSSS (section 2.7). Therefore, the ERTP-2016 does not comply with section 7(a)(2) of the Act, which mandates that each Federal agency shall, in consultation with and with the assistance of the Service (as delegated by the Secretary of the Interior), ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species.

When the Service makes a finding of jeopardy or adverse modification, subsection 7(b)(3)(A) of the Act directs the Service to suggest those reasonable and prudent alternatives (RPAs) that we believe would not violate subsection (a)(2) and that the Federal agency could take in implementing the agency action. Regulations at 50 CFR §402.02 define RPAs as alternative actions identified during formal consultation that:

- Can be implemented in a manner consistent with the intended purpose of the action;
- Can be implemented consistent with the scope of the federal agency's legal authority and jurisdiction;
- Are economically and technologically feasible; and
- The Service believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Our analysis of the effects of the Action under section 2.5 of this BO identified primary attributes of CSSS habitats that are influenced by the Corps' management of water under the ERTP-2016, and are linked to recent declines in the species' numbers, reproduction, and distribution.

The current declining population of CSSS and continued foreseeable alteration of habitat under the ERTP-2016 was the basis of our jeopardy finding in section 2.7. The actions identified in this section are additions to or modifications of the suite of actions that comprise the Proposed Action, *i.e.*, the RPA is the Service's recommended addition to the ERTP-2016, and the ERTP-2016 is otherwise unchanged. Adopting this RPA is a commitment to adaptively managing the system. The Service recognizes the need to further coordinate with the Corps to modify and augment the RPA actions, and possibly even the habitat objectives, based on an evaluation of monitoring results, in order to ensure that the Corps' water management under the ERTP-2016 is not likely to jeopardize the continued existence of the CSSS.

This section of the BO describes a single RPA that the Service has developed in discussions with the Corps to comply with section 7(a)(2) of the Act. We do not provide additional RPAs, because the recommended RPA is a performance-based approach intended to achieve the habitat outcomes identified. To the extent we are able at this time, we have specified management actions that we believe will achieve these outcomes, but we must also rely on a commitment to adaptive management, *i.e.*, to revise management actions over time as necessary to achieve the intended outcomes based on monitoring. It is the Corps' decision whether to adopt this RPA, to propose other RPAs or modifications not yet considered, or to apply for an exemption from the requirements of section 7(a)(2) under section 7(g). The Corps is required to notify the Service of its final decision on the implementation of the RPA.

The RPA is designed to:

- Provide habitat conditions that will continue to facilitate CSSS breeding in areas where the existing habitat is of better quality;
- Provide habitat conditions that will allow the CSSS to successfully breed and recruit in currently degraded areas;
- Promote CSSS population resilience by identifying additional areas of habitat expansion or movement that may occur with implementation of water management projects and the onset of sea level rise; and
- Monitor and demonstrate that successful CSSS breeding and recruitment is occurring in response to the implementation of management actions.

The Service expects that successfully implementing the RPA will:

- Eliminate the ongoing loss of functional CSSS habitat resulting from the invasion of woody and exotic plant species due to water management practices; and
- Restore/enhance CSSS habitat west of Shark River Slough and in Taylor Slough.

To verify the effectiveness of these habitat improvements, along with other actions that are being performed by other entities, the CSSS must exhibit a trend towards the following demographic characteristics included in the current recovery plan:

- A 100-year probability of persistence [T(N)] that is greater than or equal to 80 percent (±0.05);
- A rate of increase (r) for the total population that is greater than or equal to 0.0 as a 3-year running average for at least 10 years;
- A minimum of three stable, self-sustaining core breeding areas are secured;
- A stable age structure is achieved in the core populations; and
- A minimum population of 6,600 birds is sustained for an average of 5 years, with all fluctuations occurring above this level.

In developing this reasonable and prudent alternative, the Service has given full consideration to all comments and information received from the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida pursuant to Department of the Interior Secretarial Order #3206 entitled, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act (June 5, 1997)." The Service has ensured that the recommended alternative does not discriminate against such tribes in any fashion whatsoever. The Service is aware that tribe members use lands within the ERTP-2016 project area, including WCA-3A, for the purpose of hunting, fishing, frogging, subsistence agriculture, and other traditional uses. Implementation of the recommended alternative will not cause the degradation and destruction of tribal lands, resources, and assets. Moreover, as provided in the ERTP-2016 Proposed Operational Scenario described in Appendix F, the Corps will carefully monitor trends in WCA-3A water elevations and weather forecasts to assess any potential risks to health and safety posed by high water conditions. The Corps' existing operational procedures (Corps 2011, ERTP FEIS at xxvi) specify that the Chairman of the Miccosukee Tribe of Indians of Florida or his designated representative may recommend changes to the operations of the S-12 structures or other parts of the system if the Tribe determines that conditions indicate jeopardy to the health or safety of the Tribe. Therefore, the recommended alternative is consistent with both the general trust obligation of the United States to Native Americans and any responsibilities pursuant to the 1982 Florida Indian Land Claims Settlement Act, which provides for certain lands partially located in WCA-3A to be held in trust for the use and benefit of the Miccosukee Tribe of Indians of Florida.

7.1. DESCRIPTION OF THE REASONABLE AND PRUDENT ALTERNATIVE

Based on the best commercial and scientific data available, the hydrologic characteristics of CSSS habitat that are most relevant to its survival and recovery are:

- Consecutive dry days (water below ground surface) during the breeding season (March 1 – July 15), which influences nesting success; and
- Annual discontinuous hydroperiod (water above ground surface), which influences, along with fire regimes, the structure and composition of plant communities that provide CSSS habitat.

Achieving at least 90 consecutive dry days each nesting season provides CSSS populations the opportunity to nest twice annually, which is necessary for this species to increase to levels that are not vulnerable to periodic large-scale impacts, such as hurricanes, that could precipitate its extinction. A range of 90–210 discontinuous wet days during the remainder of the year maintains the prairie-grass-dominated vegetative community that the CSSS requires. A wetter regime leads to a sawgrass-dominated community, and a drier regime leads to a tree-dominated community, both of which are unsuitable for the CSSS.

The ERTP-2016 as proposed involves only minor modifications of the water management regime of recent years, which has adversely affected CSSS nesting success and habitat availability in various portions of the species' range, which is entirely within the ERTP-2016 action area. The Service expects that continuing these adverse effects will appreciably reduce the species' likelihood of survival and recovery in the wild by further reducing its numbers, reproduction, and distribution. Avoiding this appreciable reduction to comply with section 7(a)(2) necessarily involves relieving the continuing adverse effects of water management on nesting success and the plant community types that sustain the CSSS. Such relief should increase the inter-annual frequency of greater than 90 consecutive dry days during the nesting season and maintain a range of 90–210 wet days during the rest of the year in as much the species' range as is reasonable and prudent.

This RPA is organized in three sections: Targets (section 7.1.1); Actions and Timelines (section 7.1.2); and Adaptive Management (section 7.1.3). The Targets section provides spatially-specific measurable objectives related to the general goals of annually providing 90 consecutive dry nesting-season days and an annual discontinuous hydroperiod of 90–210 days. The Actions and Timelines section describes those water management actions that, in the Service's judgment in consultation with the Corps, represent the best available means of achieving the Targets in a manner that is consistent with the definition of an RPA. The overarching requirement of an RPA is to avoid the likelihood of jeopardizing the species. The status of the CSSS has become so precarious that immediate actions are required to stop the current decline in habitat quality and population numbers; and put the sparrows on a pathway to improvement. Therefore, the Actions and Timelines section also provides specific completion dates for various project features and operational changes that are relevant to achieving the Targets. Lastly, the Adaptive Management section addresses the need to monitor and evaluate progress towards achieving the Targets, and whether doing so is proving effective for the conservation of the CSSS. The Service believes that this RPA will prove effective in increasing the frequency of achieving the habitat targets, and that doing so will benefit the CSSS. However, this outcome is not certain, and we recognize the need to collect and evaluate data on the results of management actions and to adjust those actions as necessary when they are not achieving the desired objectives.

The Service understands that implementing each of the actions listed in section 7.1.2 is subject to various contingencies, including real estate acquisitions by DOI and the Corps, timely completion of several ongoing and planned construction projects, and complying with NEPA, some of which the Corps does not control (e.g., non-Corps land acquisition, tribal consultation, state CZMA evaluation). These actions must proceed in accordance with applicable federal laws and regulations, and are subject to the administrative and Congressional budget process, appropriations, the Federal Acquisition Regulations and Competition in Contracting Act requirements, and the actions of third parties, which may delay or otherwise require changes to their execution. Where possible, the Service has used the Corps' current work schedule to guide implementation of the RPA actions. The Adaptive Management features of the RPA are intended to collect and respond to new information, including action-implementation contingencies as described above, in order to keep the RPA on track to achieving its objectives and minimize the need to reinitiate consultation. Contingencies that substantially preclude or delay RPA implementation, as determined by the leadership and technical team as part of its bi-annual review, would represent a change to the action not considered in this BO that would warrant a reinitiation of consultation. In rendering this determination, the leadership and technical team will consider the best available scientific information, including whether the amount or extent of incidental take, as set forth in the Incidental Take Statement, has been exceeded.

Given the contingencies of implementing the RPA and the urgency of the need to reduce adverse effects to the CSSS, it is appropriate to limit the applicability of the findings of this BO to a time frame within which we expect the RPA's replacement with new actions governing water operations and associated consultations. Therefore, unless this consultation is reinitiated per the criteria of the Reinitiation Notice (Section 10), the RPA, the findings of this BO, and the exemption of incidental take provided in the Incidental Take Statement (Section 8) are effective until July 22, 2021.

By adopting this RPA, the Corps may proceed with water management actions of the ERTP-2016 facilities in compliance with section 7(a)(2). Incidental taking of listed species that is in compliance with the terms and conditions of the Incidental Take Statement attached to the RPA is exempted from the applicable prohibitions under section 9 and adopted by regulation under section 4(d). The Corps is required to notify the Service of its final decision on the implementation of the RPA.

7.1.1. Targets

The following set of targets has been developed to improve the conditions for the CSSS and contribute towards the survival and recovery of the species. These desired targets will require the work of various agencies and construction of additional infrastructure to accomplish. Some of this additional infrastructure is associated with CEPP. Based on current model output, the Service acknowledges that these targets are not technologically feasible for all subpopulations in every year at this time. However, the actions included in this RPA have been developed to move conditions toward the targets by providing the maximum benefits for the CSSS and its habitat with the features that are currently in place or will be in place in the near future.

1. Dry nesting days

To produce multiple broods each year, the CSSS requires at least 90 consecutive dry days (water below ground surface) during the nesting season (March 1 – July 15). The Corps will manage water levels in a manner aimed at meeting the following:

a. Subpopulation A - At least 24,000 acres of suitable habitat within and adjacent to CSSS subpopulation A must have 90 consecutive dry days between March 1 and July 15 (CSSS breeding season) every year.
b. Subpopulations B through F – At least 40 percent of each designated CSSS critical habitat unit must have 90 consecutive dry days between March 1 and July 15 (CSSS breeding season) every year.

2. Discontinuous hydroperiod

The marl prairie habitat that the CSSS requires for its survival and recovery persists under a hydrologic regime of 90 – 210 wet days (water above ground; discontinuous). In order to maintain and restore a sufficient area of suitable marl prairie habitat for each CSSS subpopulation, the Corps will manage water levels in a manner aimed at meeting the following:

a. Subpopulation A – At least 24,000 acres of suitable habitat within and adjacent to CSSS subpopulation A must show a 4-year running average discontinuous hydroperiod range of 90-210 days, with no 2 consecutive years failing to meet this target.
b. Subpopulations B through F – At least 40 percent of each designated CSSS critical habitat unit must show a 4-year running average discontinuous hydroperiod range of 90-210 days, with no 2 consecutive years failing to meet this target.

3. Other Targets

The removal of the MRSHOP water gauges produced a gap in our ability to monitor portions of the eastern CSSS subpopulations. In the absence of these gauges, the Service recommends that the Corps utilize the USGS EDEN TransectPlotter program for plotting daily water level surfaces and ground elevation profiles (Corps 2014, Appendix A). This analysis should include identification of EDEN grid cells in a transect 0.6 mile west of L-31, L-31W, and C-111 in eastern ENP (Transect A), and EDEN grid cells in a transect about 1.5 miles west of Transect A (Transect B). An analysis of water levels from the EDEN daily water-level surfaces and ground elevations along each transect should be conducted. The water surface should be analyzed in real time over the March 1 to July 15 time period to provide a comprehensive assessment of hydrology for this area and to discern effects of water control operations on the CSSS. Pending further action and evaluation, the Corps will manage water levels to the maximum extent practicable to achieve the following condition:

a. Between March 1 and June 1, ensure that operations do not raise water levels above the ground surface in subpopulations C, D, and F in areas beyond 0.6 mile of the S-332 Detention Areas.

The Corps will conduct an analysis of the S-332 Detention Areas to determine how operations of these facilities affect habitats for the eastern CSSS populations during the nesting season. This analysis will inform real-time operational decisions considering the spatial effects of operations in sparrow habitat including whether the re-activation of the MRSHOP gauges is needed.

7.1.2. Actions and Timelines

The following actions are required to meet the habitat targets defined above. The Corps will track its implementation of some of these actions (such as water control operations) on a daily/weekly basis and communicate the status of all actions to the Service as appropriate through regular inter-agency discussions. Additional details on these actions are in Appendix F.

1. Actions to Move Water East

There are several actions that can be implemented to reduce the amount of water that currently flows over subpopulation A and shift those flows to the east while still maintaining the eastern subpopulations (B-F). The movement of water towards the east into Shark River Slough and further downstream into Taylor Slough are major components of the CERP. Implementing the following actions will not only provide benefits to subpopulation A, but will also benefit parts of the drier eastern subpopulations and provide additional water to areas such as Florida Bay, which have experienced impacts from decreased freshwater flows.

a. S-12 and associated structures closures - The S-12A/B and associated structures direct water flows to the north of subpopulation A, resulting in increased hydroperiods within this area. A delay in opening and implementing early closure of the S-12A, S-12B, S-343A/B, and S-344 structures beyond their current restrictions is needed to limit flow into western Shark River Slough and provide drier conditions for this region. The expanded closure period (October 1 through July 15) for the S-12A, S-12B, and associated structures, as outlined in Appendix F, will require the increased use of various features for additional outlet capacity from WCA-3A as described in the following actions. Upon conclusion of NEPA analysis for Increment 1, the Corps will promptly adjust water management operations for the expanded closure periods for the S-12A, S-12B, and associated structures as appropriate.
    i. The Service and Corps will develop an agreed upon survey protocol by May 31, 2017, to address necessary actions needed to ascertain if nesting or breeding behavior is occurring in CSSS-A after the scheduled opening date, July 15, for the S-12A/B and associated structures. This protocol will address continued monitoring and actions to be considered prior to opening the structures in order to minimize adverse effects to the CSSS.

b. L-29 increased canal stage
    i. The Corps has planned several steps to allow more water from WCA-3A to move to the east and under the Tamiami Trail Bridge into Shark River Slough including raising the maximum stage in the L-29 canal. To accomplish this, the Corps shall develop and adopt water operations plans that allow the L-29 stage to be expeditiously raised starting with Increment 1 Plus, Increment 2, and the COP. The Corps shall proceed as scheduled for completing NEPA analysis on Increment 1 Plus and, as allowable by law, raising L-29 canal levels up to 7.8 ft NGVD prior to March 1, 2017, Increment 2 and, as allowable by law, raising L-29 up to 8.5 ft NGVD prior to March 1, 2018, and COP in 2019. Upon conclusion of each NEPA analysis, the Corps will promptly adjust water management operations accordingly.
    ii. The Corps shall use pre-emptive releases along with existing operational flexibilities and the additional capacity gained during Increment 1 Plus, Increment 2 and COP to reduce the necessity of opening S-12 A/B during the closure period.

c. S-333 - In order to prevent excessive water levels within WCA-3A, the Corps shall utilize the S-333 for increased pre-emptive releases from WCA-3A.

d. Decomp Physical Model Structures – Decomp Physical Model (DPM) is a statutorily-constrained, set of temporary features constructed as part of testing the potential design of future decompartmentalization efforts. The purpose of the operational testing of these design features is to obtain data regarding the movement and effects of water flowing from WCA-3A into WCA-3B across the L-67 canal and levee. The Corps, in partnership with the SFWMD and subject to the successful completion of NEPA and other environmental requirements, will continue to operate this design effort pursuant to State Water Quality Certification to obtain additional useful design information through FY 2017 and FY 2018. This effort includes the operation of the temporary S-152 structure. The DPM is not an authorized permanent construction modification to the C&SF Flood Control system, specifically L-67. There is no authority to utilize this design physical model beyond its function to gather data to inform the design of yet to be authorized projects. Moreover, under the NEPA documentation for this effort, the model features are to be removed. The time-limited nature of this effort is required to ensure legal compliance with the Water Resources and Development Act 2000, P.L. 106-541, Section 601(b)(2)(D)(iv), which specifically prohibits appropriations for construction of decompartmentalization projects until the completion of the Modified Waters Deliveries project. However, the continued utilization of the DPM during the time-limited testing effort is expected to provide indirect and incidental benefits to the CSSS.

2. Operations Timelines

   a. Modified Waters Delivery Increment 1 Plus – The Corps will proceed as scheduled for completing NEPA analysis on Increment 1 Plus. NEPA for Increment 1 Plus will consider raising L-29 canal levels up to a maximum of 7.8 ft NGVD. The operations associated with the emergency deviation from February – May 2016 provided insight as to the effects of raising the stage in the L-29 canal, along with other actions. The information gathered during the emergency deviation shall be used to inform the NEPA process and expedite raising L-29 canal levels above 7.5 ft in Increment 1 Plus (up to 7.8 ft) so it can be utilized by March 1, 2017. The use of the L-29 stage flexibilities is expected to reduce the need to utilize the S-12A and S-12B structures for water releases under normal operating conditions.
   b. Modified Waters Delivery Increment 2 – The Corps will proceed as scheduled with a goal of completing NEPA analysis on Increment 2 in 2018. NEPA for Increment 2 will consider raising L-29 up to a maximum of 8.5 ft NGVD. The Corps shall expedite the implementation of operations to raise the L-29 canal levels to 8.5 ft (Increment 2) prior to March 1, 2018. The increased use of the L-29 stage flexibilities is expected to further reduce the need to utilize the S-12A and S-12B structures for water releases under normal operational conditions. Completion of 8.5 SMA features is required prior to implementing Increment 2.
   c. Combined Operations Plan (COP) – The Corps will proceed as scheduled for completing NEPA analysis for COP in 2019. The operations associated with the emergency deviation from February – May 2016 provided insight as to the effects of raising the stage in the L-29 canal, along with other actions. The information gathered during the emergency deviation along with Modified Waters Delivery – Increments 1 and 2 shall be used to inform full implementation of the COP so it can be implemented in 2019. Included in COP would be the revision of the WCA Regulation Schedule.

3. Western Flows

   a. Study effectiveness of L-28 backfill
      i. The 2016 high-water emergency resulted in the need to utilize the S-344 structure on the L-28 canal. As a prerequisite to opening the S-344, the SFWMD rehabilitated the 6 canal plugs to reduce the potential effects of increased flows on the western side of CSSS-A. The Corps shall work with the Service to provide an analysis of the potential effects of Western Flows (*i.e.*, the effect of infrastructure and operation of the L-28 canal, L-28 Tieback, the S-343A, S-343B, S-344, Tamiami Canal, Loop Road, and all associated bridges and culverts), including the S-344 and L-28 plugs, on CSSS-A, and if necessary a seepage study analysis to include the southwest corner of WCA-3A will be conducted. This analysis will be considered in the Western Everglades Restoration Project which will be initiated by August 2016.
      ii. The results of the above analysis and previous studies shall be used as appropriate to formulate recommendations and implement projects (which could include full back-fill of L-28 and improved flows to Big Cypress National Preserve through S-344/ S-343) that will reduce/eliminate detrimental effects to the CSSS and its habitat.
      iii. The Corps will continue to collect data from the S-344 emergency deviation and in conjunction with the Service will analyze the data collected. This data and analysis will be used to inform the Western Everglades Restoration Project study.

7.1.3. Adaptive Management

The Corps will evaluate the effectiveness of the RPA actions relative to the targets defined in section I through monitoring, reporting, and interagency meetings conducted throughout the term of the BO, as described below.

1. Nesting Dry Days and Annual Hydroperiod

The Corps will use best available methods to monitor and estimate the spatial and temporal extent of hydrologic conditions (water above or below ground surface) relative to the targets defined in section 7.1.1. The Corps will provide a report to the Service on the results of this monitoring at least twice annually and at least 2 weeks in advance of the bi-annual review meetings under #4 below. The first report will evaluate the nesting season conditions and include information such as a review and evaluation of the previous nesting season, the operations that occurred and their effectiveness, and the spatial and temporal extent of hydrologic conditions (consecutive dry nesting days) within each subpopulation. The second report will occur prior to the initiation of the next nesting season and will include information such as a review and assessment of the annual discontinuous hydroperiod, the operations that occurred and their effectiveness, a forward looking perspective of the upcoming nesting season, and how water management operations within the flexibility available to the Corps under the Water Control Plan and approved deviations may be conducted to maximize the beneficial effects for CSSS.

2. Potential Effects to Eastern Subpopulations

The Service understands that some of the actions included in the RPA may result in changes to hydrologic conditions along the eastern CSSS subpopulations, such as increased hydroperiods in CSSS-F and CSSS-D and along the western side of CSSS-E. In consultation with the Service and Everglades National Park, the Corps will ensure that ongoing vegetation monitoring within CSSS-A and the eastern subpopulations is conducted to determine the effect of modified hydrologic conditions on CSSS habitat. The Corps will provide a report on the results of ongoing monitoring annually to the Service by December 31.

3. Annual Population Surveys

The goal of this RPA is to curtail and reverse the adverse effects of water management on CSSS habitats and provide conditions that allow for the population to approach the sparrow numbers that were present prior to the steep decline after 1992. The Service's overall population target for recovery of CSSS is a minimum of 6,600 birds sustained for an average of 5 years, with no fluctuations occurring below this level. The target of 24,000 acres of suitable habitat within and adjacent to subpopulation A could support approximately 2,100 birds if it were fully occupied. The target population of 2,100 birds in subpopulation A is close to the level that occurred prior to the crash in the early 1990s and is meant to allow for the long-term survival of this subpopulation.

To determine whether habitat improvements are actually benefiting the CSSS, the Corps will ensure that appropriate annual population surveys are conducted for all CSSS subpopulations. The Corps will confer with the Service, Everglades National Park, and USGS to determine whether to modify the current survey protocol. The Corps will provide a report on the results of the surveys annually to the Service by December 31.

4. Conduct Bi-Annual Reviews of Progress by an Interagency Coordination Team (ICT)

A leadership group, composed of senior management from the Service and the Corps, will meet at least twice annually (once after the nesting season and a second meeting prior to the start of the nesting season) to evaluate progress toward meeting the performance targets and to ensure that the RPA is effectively implemented. The Service and the Corps agree to implement an adaptive management process which may provide the mechanism for amendments to the current BO in lieu of preparation of a new BO. However, this may involve reinitiating the consultation if any of the conditions under the Reinitiation Notice at the end of this BO are triggered. The Service and the Corps' leadership group's determination about whether to reinitiate consultation will be based on the best available science.

An interagency coordination team (ICT), made up of technical scientific staff from Federal and State Agencies and Federally recognized Tribes, will meet at least twice annually (once after the nesting season and a second meeting prior to the start of the nesting season) to evaluate progress toward meeting the performance targets. The ICT may provide scientific input to the Service and Corps' leadership group.

7.2. EFFECTS OF THE REASONABLE AND PRUDENT ALTERNATIVE RELATIVE TO THE PROPOSED ACTION

The RPA modifies water management actions under the ERTP-2016 to achieve various habitat objectives as described above under section 7.1.1 that we expect will reduce adverse effects to the CSSS and thereby avoid jeopardizing its continued existence. This section considers how the RPA may further alter the effects of the ERTP-2016 to re-examine our previous biological conclusions for listed species and designated critical habitats. This re-examination includes a revised estimation of anticipated taking of listed species (CSSS, snail kite, and wood stork) resulting from the RPA to support issuing an Incidental Take Statement for the RPA.

7.2.1. Cape Sable Seaside Sparrow

Actions are necessary by the Corps to address the conservation needs of the CSSS and the intended conservation function of its critical habitat to: (1) provide adequate habitat conditions as described in the table above that will allow the sparrow to successfully breed and recruit in currently degraded areas ; (2) provide adequate habitat conditions as described in the table above that will facilitate sparrow breeding in areas where the existing habitat is of better quality; and (3) maintain the future of the sparrow population by identifying additional areas of habitat expansion or movement that may occur with implementation of water management projects or the onset of sea level rise. In addition, it is essential to monitor and demonstrate that successful sparrow breeding and recruitment is occurring with implementation of management actions.

The modeling performed by the SFWMD, at the request of the Corps, includes sets of progressively more complex operational scenarios structured to have environmental benefits throughout the study area including for the CSSS (Table 33). These scenarios include variations of the S-12A/B closure regimes (R1A, R1B, R1C, R1D, R1E), additional flexibilities added to the previous S-12A/B closures and the i-Model run (R2F, R2G2, R2H, R2I), inclusion of Increment 1 with R1B and R2H closures (INCR1B, INCR1H), inclusion of Increment 2 operations with R1B and R2H (INCR2B, INCR2H), and finally, the R1B and R2H scenarios with the inclusion of Increment 2 with the S-152 structure from the Decomp Physical Model and a revised WCA-3A Rainfall Plan (INCR1B2, INCR2H2). Specific details of what was included in each model run can be found in Table 33 and a more detailed discussion can be found in Appendix E.

Model results indicate that an increase in the duration of closures for the S-12A/B and associated structures alone tends to result in increased water levels within WCA-3A, resulting in increased seepage and possible overtopping of the S-12s during high water events. To address the potential increased stages in WCA-3A, decrease the flows to CSSS-A, and provide additional flexibility in the system, the Service's RPA includes additional capacity to move water to the east, away from CSSS-A, through WCA-3B and by increasing the stages in the L-29 canal when necessary. Model results demonstrate that these added flexibilities result in improvements to the discontinuous hydroperiod and consecutive dry days (Tables 36, 37 and 38). After review of the model runs, the Corps and Service have determined that a hybrid of the R1B and R2H runs provide the benefits included in the RPA. This hybrid includes the S-12A/B closure regime of R1B (October 1 through July 15) and the South Dade Operations of R2H. Therefore the analysis was based on the effects of R1B for the western subpopulation and WCA-3A and the effects of R2H on the eastern subpopulations. Given that the operations of the system will be changing as each incremental field test is completed we used the following time frame for each: July 15, 2016, to March 1, 2017, (R1B and R2H), March 1, 2017, to March 1, 2018, (INCR1B and INCR1H), and March 1, 2018, to March 1, 2019, (INCR2B and INCR2H). A detailed discussion of what is included in the modeled hybrid scenario is in Appendix F. A detailed discussion of how the structures were operated within the model scenarios is included in Appendix E.

To obtain a better understanding of the effects of the RPA relating to discontinuous hydroperiod and dry nesting days and success in achieving the criteria for all subpopulations, an analysis was conducted to determine how many acres met the targets on 40 percent of each subpopulation, or 24,000 acres in the expanded CSSS-A (CSSS-Ax) (Figure 47). The number of years in both the INCR2B and INCR2H scenarios, out of the total of 41 years (1965-2005) meeting the discontinuous hydroperiod target in many subpopulations still falls short of what is needed for CSSS recovery, ranging from 27 to 49 percent (Table 34). In CSSS-A, the model indicates that the proposed operations provide an increase in the number of years meeting the target compared to the existing condition from 9 years in the ECB16 to 11 years under INCR2B. In CSSS-Ax, that number is improved from 16 years in ECB16 to 20 years under INCR2B. This suggests improvements in the total area meeting the targets and improved conditions that may be expected in the expanded area to the east of the currently delineated boundary CSSS-A. This improved acreage in CSSS-Ax may provide for improved habitat expansion for this subpopulation, but it needs to be more fully investigated to better understand the current habitat conditions. In CSSS-C, the model indicates that the proposed operations provide an increase in the number of years meeting the target compared to the existing condition from 16 years in ECB16 to 19 years under INCR2H. Alternately, for CSSS-F, the model indicates that the proposed operations result in a decrease in the number of years meeting the target compared to the existing condition from 22 years in ECB16 to 13 years under INCR2H. No significant changes are indicated for INCR2H from ECB16 in CSSS-B (20 years) and CSSS-D (18 years), and only a slight decrease in CSSS-E (21 years in ECB16 to 20 years under INCR2H) based on this metric.

For the consecutive dry days target (Table 34) the target criteria is met much more consistently in most subpopulations over the period of record but still falls below the target number of years between 41 to 90 percent of the time (Table 34). CSSS-A and CSSS-D have the lowest number of years overall, but show improvement compared to ECB16 (CSSS-A from 16 years in ECB16 to 18 years with INCR2B, and CSSS-D from 18 years in ECB16 to 20 years under INCR2H). CSSS-Ax shows the greatest improvement of any area for this metric, increasing from 21 years in ECB16 to 25 years for INCR2B. Notably CSSS-E indicates a decrease from the baseline of 30 years to 26 years with INCR2H for this metric. No significant changes are indicated for INCR2H from ECB16 in CSSS-B (37 years) and CSSS-C (36 years), and only a slight decrease in CSSS-F (from 32 years to 31 years) based on this metric.

Finally, the Service conducted an analysis of the annual difference in acres between the ECB16 (baseline) condition and the INCR2B and INCR2H modeled scenarios in the

90-210 day discontinuous hydroperiod range target and the March 1 to July 15 consecutive dry days ≥ 90 range target, for the 1965 – 2005 period of record for each CSSS subpopulation (A-F) and for CSSS-Ax (Tables 35 and 36). The average difference for the period of record is also shown as well as the number of years the difference is an increase or decrease.

For discontinuous hydroperiod, the average annual change from ECB16 to modeled scenario for CSSS-Ax was an increase of 2,891 acres for INCR2B (9 years decrease and 31 years increase) (Table 35). Alternately, in CSSS-D, CSSS-E, and CSSS-F, the average annual change from ECB16 to modeled scenario INCR2H decreased, ranging from -308 to -968 acres for INCR2H (11 to 12 years increase and 24 to 28 years decrease) (Table 35). Less distinct differences were indicated for CSSS-B and CSSS-C for this metric. While the average acreage change for CSSS-B was only -127 acres, the model scenario INCR2H exhibited the number of years with decreasing values for INCR2H as 21 years, with only 17 years increasing in acreage meeting this target, indicating that there is an effect of water management operations on CSSS-B.

For consecutive dry days, the average annual change from ECB16 to modeled scenario for CSSS-Ax was an increase of 2,203 acres for INCR2B (10 years decrease and 29 years increase) (Table 36). Alternately, in CSSS-B and CSSS-E, the average annual change from base to modeled scenario decreased ranging from -209 to -1,417 acres for INCR2H (1 to 6 years increase and 22 to 27 years decrease (13 years no change) (Table 36). This metric showed that the net average change in acreage was generally small (30 to 263 acres on average) in CSSS-C and CSSS-D, however, some improvement in the number of increasing years was indicated for INCR2H (11 years performed better in CSSS-C and 19 years in CSSS-D). While the average acreage change in CSSS-B was small (-209 acres) for INCR2H, the number of years with decreasing acreages for INCR2H was 22 years, and only 6 years increased, again indicating that water management operations appears to negatively affect CSSS-B.

In summary, the above analysis shows that, under model scenario INCR2B, the western subpopulation CSSS-A and CSSS-Ax is being benefited, and there are variable effects on the eastern subpopulations CSSS-C, CSSS-D, CSSS-E, and CSSS-F. Of particular concern are the apparent negative effects on CSSS-E, the second largest subpopulation, which appear to be as a result of increased restoration flows in Shark River Slough, including implementation of Increment 2 as demonstrated by model run INCR2H. These effects will need to be monitored closely and adaptive operations, potentially including seasonal limitations on water levels in the L-29 Canal, may need to be considered during the transitional period covered by this consultation. The assumption to date that CSSS-B is relatively unaffected by water management operations has been brought into question based on the analysis of these model runs and also requires further investigation to more fully understand what is occurring. Finally, although the overriding goal of Everglades restoration, to move water to the east back into its historic flow way in Shark River Slough and away from the western subpopulation, is beginning to be demonstrated, the habitat and breeding conditions necessary to begin recovery of the Cape Sable seaside sparrow are still not being fully achieved.

To verify the effectiveness of these habitat improvements on the recovery of the CSSS, along with other actions that are being performed by other entities, CSSS populations must exhibit a trend towards the following demographic characteristics: reversal of the loss of functional CSSS habitat which was a result of current and past water management practices, and the invasion of woody and exotic plant species; restoration of CSSS habitat west of Shark River Slough and in Taylor Slough, which has been degraded by current and past water management practices; when demographic information on the Cape Sable seaside sparrow supports, for a minimum of 5 years, a probability of persistence [T(N)] that is equal to or greater than 80 percent (±0.05) for a minimum of 100 years; when the rate of increase (r) for the total population is equal to or greater than 0.0 as a 3-year running average for at least 10 years; when a minimum of three stable, self-sustaining core breeding areas are secured; when a stable age structure is achieved in the core populations; and, when a minimum population of 6,600 birds is sustained for an average of 5 years, with all fluctuations occurring above this level.

7.2.2. Cape Sable Seaside Sparrow Critical Habitat

Currently, consistently suitable conditions for the CSSS are present only in CSSS-B and CSSS-E on a regular basis. Evaluation of the model runs has provided some insight for comparisons between different scenarios. The model run most representing the RPA, INCR2H, indicates that habitat conditions are expected to improve in many areas designated as critical habitat. Based on analysis of the model output performed by USGS (Beerens et al. 2016), the interannual variability in hydroperiod increased the least under the R2H scenario, the base condition for INCR2H. For CSSS-C, R2H provided the best results for above average rainfall years. CSSS-C and CSSS-F demonstrated increased annual hydroperiods, remedying the current dry conditions and providing for more suitable marl prairie conditions. Overall, scenario R2H reaches the hydroperiod and depth suitability targets more than the other scenarios analyzed while minimizing negative consequences of increased Shark River Slough flows on CSSS-E. Based on the model results, we expect to see an increase in improved habitat conditions and therefore find that the RPA will not result in adverse modification of critical habitat.

7.2.3. Everglade Snail Kite

This RPA confirms the goals of ERTP-2016 and identifies some potential ways to move water east from WCA-3A to WCA-3B and from WCA-3A to Shark River Slough. The RPA also accelerates the schedule for other components and operations that were recognized under ERTP-2016.

For model scenario INCR1B, which represents potential operational changes in WCA-3A under Increment 1 Plus, the net stage difference in terms of the annual water stage was slightly deeper (0.10-0.25 ft) in the northeastern portion of WCA-3B and NESRS (Figure 49). Under this scenario, no significant changes to the average annual hydroperiod or average annual stage are expected to occur within WCA-3A or southern WCA-3B (Figures 48 and 49). Under model scenario INCR2B, which represents potential additional operational changes under Increment 2, no significant changes to average annual hydroperiod or average annual stage are anticipated to occur within the WCAs (Figure 50 and 51).

The greatest changes to conditions that may affect the snail kite are likely to occur within ENP. Model scenario INCR1B indicated the annual stage would decrease slightly in the vicinity of CSSS-A (up to 0.25-0.5 ft), and increase by 0.10 to 0.25 feet in Shark River Slough (Figure 49). The resulting annual hydroperiod was shortened by 30 to 45 days in northeastern portions of CSSS-A, shortened by up to 90 days in areas east of CSSS-A, and increased by up to 90 days in northeastern ENP in NESRS (Figure 48). Under model scenario INCR2B, changes to the average annual stage and hydroperiod are expected to be more significant. INCR2B results in an average annual stage increase of up to 1.0 feet in Shark River Slough and other portions of northeastern ENP and a decrease of up to 0.5 feet in and around CSSS-A (Figure 51). In addition, INCR2B would result in an increase in the average annual hydroperiod of as much as 137 days in areas of northeastern ENP near CSSS-F and CSSS-E (Figure 50). However, this scenario results in a decrease in the average annual hydroperiod within portions of CSSS-A and areas to the east of CSSS-A by as much as 90 days and no change to stage or hydroperiod in WCA-3A.

The hydrologic model results for model scenarios INCR2B and INCR1B were evaluated on an average annual basis. Due to the nature of the stage changes (i.e., 0 to 0.5 feet higher) that are predicted to occur in areas recently (*i.e.*, last ten years) occupied by snail kites, the Service does not believe the implementation of the RPA represents an additional adverse effect to snail kites.

7.2.4. Everglade Snail Kite Critical Habitat

The hydrologic changes identified in the previous section are predicted to occur within portions of the ENP critical habitat unit for snail kites. The predicted changes in stage and hydroperiod for the RPA (model scenarios INCR1B and INCR2B) are not of sufficient magnitude to adversely affect snail kite critical habitat more than already considered in this BO.

7.2.5. Wood Stork

The implementation of the RPA has the potential to affect the wood stork through changes to the hydrology within the action area by 1) moving water further east along the L-29 canal before releasing that water south into Shark River Slough, and 2) moving water further east through operations and infrastructure along the L-28 canal and Tamiami canal. Specifically, seasonal closures of the S-12 and associated structures, increased canal stage in the L-29 canal, increased capacity for flows through S-333, operation of the Decomp Physical Model features, improved connectivity between WCA-3A and WCA-3B, and increased flows to the east will result in changes to the annual stage, hydroperiod, and wood stork foraging conditions within the action area.

The modeling performed by the SFWMD and NPS includes sets of progressively more complex operational scenarios structured to have environmental benefits throughout the study area (Table 33). The model run that most closely represents the Service's RPA for this area are the R1B scenarios including INCR1B and INCR2B which is scheduled to begin in 2018. As stated previously, water depth and recession rate are the two most important hydrological variables for wood storks (Gawlik et al. 2004). To have a successful nesting year, wood storks must have access to suitable habitat throughout the dry season, but the location of the suitable habitat can vary across the landscape. Under the selected model runs in the RSM and WADEM models, changes to the annual stage, annual hydroperiod, and mean foraging conditions are predicted to occur primarily within portions of northern and northeastern ENP as well as the northeastern corner of WCA-3B. However, results should be interpreted cautiously given the inherent uncertainty associated with the use of models.

The RSM model results for INCR1B indicate that annual hydroperiod will be shortened by 30 to 45 days in northeastern portions of CSSS-A, shortened by up to 90 days in areas east of CSSS-A, and increased by up to 90 days in northeastern ENP in NESRS (Figure 48). The model results for WCA-3A and 3B under INCR1B indicate there is no change in annual average stage within WCA-3A; however, there is an increase (0.25-0.5 higher) in annual stage from the baseline conditions within the northeast corner of WCA-3B (Figure 49).

The RSM model results for INCR2B indicate that both annual stage and hydroperiod will increase (*i.e.*, an increase in annual stage up to 1.0 feet and hydroperiod up to 90 days) in portions of northern and northeastern ENP and decrease (*i.e.*, annual stage up to 0.5 feet; hydroperiod up to 90 days) in northern ENP east of Big Cypress National Preserve and south of the Tamiami canal (Figures 50 and 51). There are no changes in the annual average stage or hydroperiod in WCA-3A under this scenario. Based on the location of known wood stork colonies, the annual hydroperiod and annual stage are expected to increase within portions of the CFA of at least five colonies (*i.e.*, Tamiami East, Tamiami East 2, Tamiami West, Mud East, and Grossman's Ridge West). Of these, the Tamiami West colony is the only one that has been active over the last five years. However, annual hydroperiod and annual stage are also expected to decrease within different portions of the CFA of these same five colonies. At least three additional wood stork colonies (*i.e.*, Crossover, Jetport, and Jetport South) are also expected to experience decreases in annual hydroperiod and annual stage within portions of their CFA.

The WADEM model results display no significant change in the foraging conditions in WCA-3A under INCR1B (Figure 52) and indicate similar to slightly better foraging based on the model results for INCR2B (Figure 53). The WADEM model results indicate that foraging conditions will be improved for wood storks over a large area of northern and northeastern ENP. Based on the location of known wood stork colonies, the greatest improvement to foraging conditions is predicted to occur within the CFA of at least five colonies (*i.e.*, Tamiami East, Tamiami East 2, Tamiami West, Mud East, and Grossman's Ridge West). Of these, the Tamiami West colony is the only one that has been active over the last five years.

Due to general uncertainties related to model results, the Service has determined that the implementation of the RPA is not likely to have significantly different effects to the wood stork than those described earlier in the BO as a result of ERTP-2016. In addition, the temporal distribution of the changes to foraging conditions, hydroperiod, and stage described above is unknown. It is the Service's biological opinion that the implementation of the RPA, as proposed, is not likely to jeopardize the continued existence of the wood stork. No critical habitat has been designated for this species; therefore, none will be affected.

8. INCIDENTAL TAKE STATEMENT

Sections 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Sections 7(b)(4) and 7(o)(2) provide the mechanism for such exemption to federal agency actions that do not violate section 7(a)(2). The Service finds that the proposed action of this consultation would violate section 7(a)(2) by jeopardizing the continued existence of a listed species, and suggests a reasonable and prudent alternative (RPA) that would avoid jeopardy. This Incidental Take Statement applies to the RPA, should the Corps choose to adopt it.

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Corps shall report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement.

The Incidental Take Statement provisions of the implementing regulations for section 7 of the ESA were amended in 2015 (50 CFR 402.14). One of the primary purposes of the amendments was to address the use of surrogates to express the amount or extent of anticipated incidental take. The changes were intended to improve the clarity and effectiveness of incidental take statements. As a result of the amendments, a surrogate (*e.g.*, similarly affected species or habitat or ecological conditions) may be used to express the amount or extent of anticipated take provided that the biological opinion or incidental take statement: describes the causal link between the surrogate and take of the listed species, explains why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species, and sets a clear standard for determining when the level of anticipated take has been exceeded.

8.1. AMOUNT OR EXTENT OF TAKE

8.1.1. Cape Sable Seaside Sparrows

While many components of the RPA will contribute to the conservation of the CSSS, the RPA does not avoid all adverse effects of water management operations.

Incidental take of individuals, especially nestlings or eggs, resulting from water operations is likely, either by direct drowning when routing water into CSSS habitats during the nesting season, or indirectly by making nests more susceptible to predation and other threats. High water levels can also stress adult birds reducing their fitness and making them more susceptible to predation and other causes of mortality.

Incidental take of CSSS resulting from water operations will be difficult to detect. The sparrow's reclusive habits and the general inaccessibility of its preferred habitat have long discouraged critical comprehensive life history studies (Lockwood et al. 1997). Seasoned observers typically have difficulty actually seeing individuals and usually rely on the chirping sound of singing adult males defending their breeding territory and vocalizing to attract females to determine presence or absence in an area. Detection by sound prompts more intensive searching that sometimes results in visually locating individuals and nests. Compounding these detection difficulties, the sparrow's distribution is patchy and temporally dynamic (Pimm et al. 2002).

Previous court opinions and court-ordered reviews of the Service's biological opinions have concluded that the standardized method used to estimate population abundance, known as the extensive survey method, is an insufficient basis for predicting or monitoring the amount or extent of incidental take of sparrows resulting from water management actions, because several other factors influence the species' population dynamics. However, because the species' range is fully within areas that are influenced by the Corps' water management operations, and hydrologic conditions are strongly linked to reproductive success and the persistence of the sparrow's habitat, this method can serve as the starting point for predicting the amount of incidental take that is reasonably certain to occur, and as an indicator of the amount that has occurred. Potentially all adult birds are encompassed by the extensive survey method, and the previous year's reproductive success and productivity are reflected in the current year's survey results, since CSSS are capable of breeding in the year after hatching.

The extensive survey method to estimate sparrow populations uses a helicopter to place observers at remote sites within sparrow habitat who then record the number of sparrows seen or heard. To estimate the number of sparrows from the number observed (seen or heard), a correction factor is used. Kushlan and Bass (1983) were the first to develop and use a correction factor for their sparrow observations and it is still used today. A value of 15.87 (rounded to 16.0) is used based on the range at which observers can detect the sparrow's distinctive song, and on the assumption that each singing male is accompanied by one female. An individual male sparrow's territory is roughly 5 acres in size and the correction factor of 16 assumes that observers will count all birds within 656 ft of the observation station. Therefore, the correction factor of 16 is based on the fraction of total area sampled and detection probability, such that the area sampled multiplied by the detection probability equals 1/16 (Pimm et al. 2002; Walters et al. 2000). For that reason, one singing male heard or one individual seen is corrected to equate to a total of 16 individuals. This assumes statistically that an additional 15 individuals were also present in the area sampled, but due to factors governing the probability of detection, were not seen or heard during the time of observation. It has been statistically determined that under good survey conditions, the chance or probability of detection is better than 60 percent using this method. The correction factor methodology has been the subject of two external reviews. The most recent review (1999/2000) was conducted as a result of a recommendation by the American Ornithologists' Union (AOU) external peer review committee. The outcome of the second review resulted in a determination by the AOU committee that the methodology employed is a reliable and accurate measure of abundance (Walters et al. 2000). However, this is not to say that it is a reliable method to track and count individual sparrows, rather it provides a reliable trend in population estimates comparable over time.

For the 2010 ERTP BO, the Service computed the mean total population estimate and standard deviation of these estimates (the customary statistical measure of variance for a set of measurements) for the years 2001-2009, which represented the timeframe under which operations for the protection of the CSSS had been implemented. Though the range of population estimates over this time frame varied due to water management and other factors, the Service determined that the mean population estimate over this time frame (2001 to 2009) had been relatively stable. Lacking methods that could separate the effects of water management from the effects of other factors, we used the standard deviation of the 9-year mean annual population estimate as a measure of all effects contributing to population variability. Subtracting the standard deviation of the population size estimates of previous years from the population size estimate of the current year represented a conservative basis for estimating the amount of incidental taking due to water management. The amount of incidental take anticipated in the 2010 ERTP BO was exceeded in 2014, and consultation was reinitiated when the total estimated population fell to 2,720 individuals.

Through this reinitiated consultation, the Service has developed a set of actions under the RPA that we believe will reduce the adverse effects of the ERTP-2016 water management and avoid jeopardizing the CSSS. Further, the status of the species has declined since the previous consultation; therefore, we must revise the amount of anticipated take associated with the ERTP-2016 as modified by the RPA. As stated previously in this BO, the preliminary 2016 CSSS population estimate is 2,416 individuals. To compute the variability in annual population size as we did for the 2010 BO and establish the starting point for estimating anticipated take, we could use the data from 2001 to the present; however, it is more appropriate to use the most recent years to reflect the current trend and variability. For this purpose, we choose to use the last 10-year period (2007-2016).

The mean population estimate for the period 2007-2016 is 2,727 sparrows with a standard deviation of 271. Rather than using one (1.0) standard deviation as the basis for estimating anticipated take as we did in the 2010, we are using one half (0.5) of the standard deviation ($271 \times 0.5 = 135$ birds) for this 10-year period, because (a) the estimated population has declined during this time; and (b) we believe the RPA will have lesser adverse effects than ERTP, due to the additional conservation measures it incorporates. **Take of 135 sparrows represents our judgment, based on best available data, of the amount of incidental take that will result from implementing the RPA**. Therefore, a decline from the 2016 population estimate of 2,416 sparrows to less than 2,281 sparrows (2,416 – 135 = 2,281) at any time during the course of the action would warrant a reinitiation of consultation.

Because survey results are not instantaneous, since it may take several months to analyze the data and develop a population estimate in any given year, the Service has also identified hydrologic parameters, described below, for monitoring to provide an earlier indication of conditions resulting from water management that are causing incidental take. These parameters, if exceeded, would indicate that the effects of the action are greater than anticipated in this BO, and would signal a potential for exceeding the amount of incidental take measured by the population estimate described above. If these parameters are exceeded, the adaptive management procedures in Section 7.1.3 would be initiated. The ICT, as a part of the adaptive management procedure, will examine causation of the exceedance and whether the exceedance resulted from water operations. The ICT will inform the Service and Corps leadership group of their findings.

Incidental take in the form of harm is anticipated to occur to individual sparrow eggs or nestlings as a result of high water levels during the breeding season. CSSS build their nests near the ground surface at an average height of only 16 cm (6 inches) between the soil surface and the base of the nest. Accordingly, they are especially vulnerable to flooding caused by rising water levels due to rainfall or water management actions. Therefore during the breeding season, the monitoring of water levels within occupied sparrow habitat will provide an additional measure of incidental take of sparrow eggs and young not yet capable of flight. We do not anticipate the loss of adult sparrows since the water levels in question are not known to directly harm adult sparrows.

Therefore, in addition to the incidental take measure described above based on the estimated total population of sparrows and recent variability in these estimates, the following measures of incidental take as described in hydrologic terms also apply to the eastern and western subpopulations. If any of these measures are exceeded, reinitiation of consultation is required.

Eastern Marl Prairies

Operation of the S-332 structures may result in flooding of sparrow nests that occur within 0.6 mile of the S-332 Detention Areas, either because of increased water levels resulting from seepage or from overflow from the detention areas directly into sparrow habitat within ENP. This will result in loss of the contents of all nests within 0.6 mile of S-332 structures. Operation of the detention areas that raise water levels from a groundwater condition to a surface water condition beyond 0.6 mile from the detention areas prior to July 15 will result in incidental take. In addition, operations that raise surface water levels beyond 0.6 mile from the detention areas will constitute an exceedance of allowable incidental take. Specific instructions for monitoring and reporting this habitat surrogate for incidental take in the eastern marl prairies are provided in section 8.5.

Western Marl Prairie

Information from various sources identifies different amounts of potential and available habitat in the western marl prairies. To date, there is still limited detailed information about the condition and susceptibility to flooding within all portions of this area; therefore, we rely upon the data that were presented in the Service's 1999 Biological Opinion.

The Service anticipates that a maximum of 74 square-miles (47,333 acres) of potential and historic sparrow habitat for the extended Subpopulation Ax is subject to flooding during the nesting season due to water releases. This area corresponds to 60 percent of potential sparrow habitat for Subpopulation Ax. Any adult birds that have territories within the 74 square-miles would be impacted by water levels too high to allow breeding or by lower fecundity associated with nest abandonment. Likewise, injury or death to juvenile sparrows or eggs could result from discharges that raise the water level above existing nests. These effects as a result of operations will be considered incidental take. Specific instructions for monitoring and reporting this habitat surrogate for incidental take in the western marl prairies are provided in section 8.5.

8.1.2. Everglade Snail Kite

After reviewing existing information, the Service has determined: (1) it is impractical to quantify the number of individual snail kites that may be incidentally taken as a result of the effects of ERTP-2016; (2) it is impractical to discern the number of individual snail kites that are incidentally taken as a result of habitat impacts from other demographic and environmental parameters that will be occurring at the same time as the action, even if it was practical to monitor each individual snail kite; and (3) current methodologies for tracking population trends are insufficient to document the incidental taking of individual snail kites or their reproductive success from a specific action in a subset of the range of the species. Further discussion and rationale for our determinations can be found within the Service's 2010 ERTP BO (Service 2010).

A reduction in the number of snail kites in WCA-3A or ENP in one year would not necessarily indicate a loss of snail kites due to the action if those unaccounted for snail kites were elsewhere in the larger system. For example, if adult snail kites that encounter high water levels in WCA-3A subsequently nest in the STAs or Lake Okeechobee, that disturbance does not necessarily indicate harm has occurred. However, the Service believes that the ERTP-2016 is likely to take snail kites in the form of disturbance of adults and juveniles that does lead to injury or mortality of juvenile snail kites and loss of nests. The mechanisms for these effects are as follows: high water stages may reduce the abundance, growth, and reproduction of apple snails and reduce woody vegetation that kites use for nesting and perch-hunting. Depending on the amount of lost snail productivity and the initial snail population size, a single year of high water during the dry season can result in long-term impacts to apple snail populations and decrease numbers of snail kite nest initiations, nest success, and juvenile survival in an area, as has been observed in WCA-3A in recent years. Rapid recession rates during the breeding season can also result in decreased nest success (through increased predation or decreased forage availability) and decreased juvenile survival (due to decreased forage availability). Potential water quality changes may benefit or adversely affect snail kite habitat suitability; however, we cannot quantify incidental take associated with those effects at this time.

We therefore re-affirm the exceedance criteria from the ERTP BO that are linked to habitat quality as a surrogate for incidental take of snail kites with the exception of "*Recession: Monthly Amplitude*" (for explanation , see Section *Evaluation of Conditions under ERTP (Water Year 2013 – present); Recession Rates*). Those exceedance criteria are:

Dry Season High Water
Timing: by April 15
Trigger Value: stage > 9.2 ft NGVD at gauge 3AS3W1
Frequency: 2 consecutive years

Wet Season High Water
Timing: June 1 – December 31
Trigger: stage > 10.5 ft at gauge 3AS3W1 for 60 days
Frequency: 2 consecutive years

Recession: Dry Season Amplitude
Timing: January 1 – May 31 (or onset of wet season, whichever is sooner)
Trigger: stage difference > 1.7 ft as measured at gauge(s) closest to kite nesting, as determined by the Service
Frequency: 2 consecutive years

For all exceedance criteria, if the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service. These incidental take surrogates are in accordance with Service policy in that they set a clear standard for determining when take has been exceeded and there is a causal link between the surrogate and the take of the species.

8.1.3. Wood Stork

Although wood storks nest colonially and often in the same site for many years, the ability to count individual wood storks and their young and attribute any changes from year-to-year as an effect of the action is complicated by many factors. First, wood stork colonies are censused as estimates and do not reflect actual counts, not all wood storks return to the same colony every year even if the colonial site is used again (Kushlan and Frohring 1986), nesting sites may be abandoned if water levels recede too far (Rodgers et al. 1996) or there is disturbance to the site and the colony or individual birds may re-nest elsewhere (Ogden 1991, Borkhataria et al. 2004; Crozier and Cook 2004). In addition, new wood stork colonies are often discovered which may represent a shift from historic colonies due to environmental conditions or establishment of a new colony (Meyer and Frederick 2004).

The annual hydrologic pattern in south Florida is consistent, with water levels rising during the wet season (June through October), then receding gradually during the dry season (November to May). Wood storks nest during the dry season and rely on the drying wetlands to concentrate prey items for optimal foraging. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging and will not be suitable again until water levels rise and the area is repopulated with fish. Wood storks prefer calm water, approximately 2 to 16 inches deep and free of dense vegetation for foraging (Coulter and Bryan 1993). More recently, Beerens and Cook (2010) defined a foraging depth range of -0.31 to 1.34 ft (-9.33 to 41.26 cm) for wood storks feeding in WCA-3A.

Accordingly, there is a general progression in the suitability of wetlands for wood stork foraging based on their hydroperiods and the distance of the wetlands from the nest. Short hydroperiod wetlands are used early in the nesting season, the mid-range hydroperiod sites are used during the middle of the nesting season, and the longest hydroperiod areas (typically slough habitat) are used later in the nesting season. Adult wood storks feed farthest from the nesting site prior to laying eggs, forage in wetlands closer to the colony site during incubation and early stages of raising the young, and then farther away again, when the young are able to fly.

The implementation of the RPA is expected to influence wetland hydroperiods causing changes in foraging suitability for wood storks. If the RPA contributes to reduced depth and hydroperiod during the preceding wet season, the effects generally result in reduced densities of wood stork prey. Additionally, if increased hydroperiod and water depth occurs during the nesting season, such effects generally result in decreased productivity and abundance of prey. Therefore, the Service anticipates incidental take in the form of harm, from reductions in foraging habitat suitability, may result in injury or death of a limited number of wood storks (eggs or nestlings) each year based on slight changes to foraging habitat suitability. Examples of this could include water level manipulations of several inches in and around the colonies which could make it more difficult for wood storks to forage and provide for young as well as increase the availability of wood stork nests to predators. In some years, conditions for wood storks may actually be favorable under operations. The Service does not anticipate widespread abandonment or nest failures as a result of the RPA.

Allowable incidental take will be exceeded if operations from implementing the RPA results in a water depth greater than 16 inches (41 cm) from March 1 through May 31 throughout WCA-3A for two consecutive years as measured by the two gauge average (based upon a ground surface elevation of 8.4 feet NGVD) at gauges 3A-3 and 3A-4. A water depth greater than 16 inches (41 cm) across WCA-3A during the nesting season would lower the suitability of foraging habitat to the point where the ability for wood storks to forage would be severely impaired and most likely result in widespread abandonment of nests and fledglings within the affected colony (Gawlik et al. 2004, J.M. Beerens, FAU, personal communication 2010).

8.2. EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of incidental take is not likely to result in jeopardy to the Everglade snail kite or wood stork, or destruction or adverse modification of critical habitat for the Everglade snail kite during the continued implementation of ERTP.

In the accompanying biological opinion, the Service determined that this level of incidental take is not likely to result in jeopardy to Cape Sable seaside sparrow if the RPA is implemented in addition to the continued implementation of ERTP.

Effective the date this Biological Opinion is signed, the incidental take provisions for the Everglade snail kite, wood stork, and Cape Sable seaside sparrow as described in this Biological Opinion are authorized.

8.3. REASONABLE AND PRUDENT MEASURES

The Service believes the following Reasonable and Prudent Measures (RPMs) are necessary and appropriate to minimize impacts of incidental take of Everglade snail kites and wood storks. RPMs are not provided for the Cape Sable seaside sparrows because we have incorporated all necessary and appropriate measures to reduce incidental take to the maximum extent practicable as features of the RPA.

1) Use operational flexibility during the implementation of the ERTP-2016 to minimize impacts related to hydrology. During periods when water regulations are not restricted by constraints, the Corps will work with the Service and other partners to identify operations that minimize detrimental impacts or reduce the future risk of detrimental impacts to the Everglade snail kite, wood stork or their habitats.

2) As requested by the Service, provide a strategy for pre-emptively operating structures in order to avoid the need for the high water strategy criteria openings of the S-12A/B. The Service requests that discharges prior to October 1 be aggressive enough to allow as much water to be moved towards the east as possible. Pre-emptive operations should strive to avoid S-12A/B openings in October and November, when practicable.

3) Obtain further information about the effects of ERTP-2016 and develop appropriate measures to further minimize impacts to Everglade snail kite and wood storks.

8.4. TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

8.4.1. Everglade Snail Kite

1) Continue the field testing and relaxing or removing the existing G-3273 gauge constraint of 6.8 ft NGVD which governs wet season utilization of S-333.

2) Continue to conduct Periodic Scientist Calls, as outlined in the Description of the Proposed Action section of this Biological Opinion, to coordinate and discuss operations that will minimize impacts to federally listed species and their habitats as well as other species and habitats (*i.e.*, state listed species and tree islands) of concern. As part of the established Periodic Scientist Call process, the Corps will investigate and discuss whether current constraints can be adjusted, such as the G-3273 gauge constraint governing S-333 operations, to allow further minimization of impacts to snail kites, their prey, and their habitat, within WCA-3A and ENP. The Corps will produce an annual assessment of the input received (the process), actions taken and the hydrologic effects of those actions (the outcomes) in partnership with participating agencies and scientists.

3) Obtain further information about the effects of implementing ERTP-2016 and develop appropriate measures to further minimize impacts. In order to assure the effects of these actions do not exceed the level of impacts anticipated in this Biological Opinion, obtain information on:

    a. The annual status of the Everglade snail kite population and apple snail populations within the action area;
    b. The reproductive effort of the Everglade snail kite population and apple snail populations within the action area, including:
        i. The number of Everglade snail kites initiating nesting in the action area, the success rate and productivity of those nesting efforts, and subsequent recruitment resulting from those nesting efforts each year; and
        ii. The amount of apple snail egg cluster production in the action area each year;
    c. Impacts of hydrologic changes caused by the action on the Everglade snail kite, its prey, and its habitat. For all exceedance criteria, if the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service within 60 days of the exceedance; and
    d. The effects of operational changes at specific structures related to these actions and their operations (Appendix F) on hydrology in the habitats occupied by the Everglade snail kite.

Monitoring plans designed to obtain the information above must be developed by the Corps and approved by the Service within 90 days of this signed Biological Opinion, and snail kite and apple snail monitoring programs must be in place prior to the beginning of the nesting season. Rangewide snail kite monitoring (as required under ERTP) must be continued through the 2016 breeding season in order to obtain estimates of the snail kite population and related breeding parameters, and to allow sufficient time for other funding arrangements to be made.

8.4.2. Wood Stork

1) Continue the field testing and relaxing or removing the existing G-3273 gauge constraint of 6.8 ft NGVD which governs wet season utilization of S-333.

2) Continue to conduct Periodic Scientist Calls, as outlined in the Description of the Proposed Action section of this Biological Opinion, to coordinate and discuss operations that will minimize impacts to federally listed species and their habitats as well as other species and habitats (*i.e.*, state listed species and tree islands) of concern. As part of the established Periodic Scientist Call process, the Corps will investigate and discuss whether current constraints can be adjusted, such as the G-3273 gauge constraint governing S-333 operations, to allow further minimization of impacts to wood storks and their habitat, within WCA-3A and ENP. The Corps will produce an annual assessment of the input received (the process), actions taken and the hydrologic effects of those actions (the outcomes) in partnership with participating agencies and scientists.

3) Obtain further information about the effects of implementing ERTP-2016 and develop appropriate measures to further minimize impacts. In order to assure the effects of these actions do not exceed the level of impacts anticipated in this Biological Opinion, the Corps must obtain information on:

    a. The annual status of wood storks populations in the action area;
    b. Determine annually the number of wood storks initiating nesting in the action area and the success rate of those nesting efforts each year;
    c. Impacts of hydrologic changes caused by the action on the wood storks and their habitat; and
    d. The effects of operational changes at specific structures related to these actions and their operations (Appendix F) on hydrology in the habitats occupied by the wood stork.

8.5. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement (50 CFR 402.14(i)(3)). Monitoring and reporting requirements relative to the actions impacts on the Everglade snail kite and wood stork are specified above as part of the terms and conditions for implementing measures to minimize incidental take. The following requirements (#1–3) are not associated with such measures for the CSSS, as none are provided, but are still necessary to comply with the regulations cited above governing the incidental take of CSSS exempted through this consultation. Requirement #4 applies to all listed species, and #5 to migratory birds and eagles.

1) Annual Population Surveys – To determine how water management is affecting the CSSS and to monitor population size and trends, the Corps will ensure that appropriate annual population surveys are conducted in all CSSS subpopulations. The Corps will confer with the Service, Everglades National Park, and USGS to determine whether to modify the current survey protocol. The Corps will provide a report on the results of the surveys annually to the Service by December 31.

2) Eastern Marl Prairies – To determine whether water management is causing incidental take of CSSS in the eastern marl prairies in excess of that anticipated in the BO, the Corps will utilize the USGS EDEN TransectPlotter program (Corps 2014, Appendix A) in combination with the USGS SparrowViewer for plotting daily water level surfaces and extent of dry CSSS habitat. Regular reporting on this metric will be included in the Periodic Science Calls.

3) Western Marl Prairies – To determine whether water management is causing incidental take of CSSS in the eastern marl prairies in excess of that anticipated in the BO, the Corps will utilize the USGS SparrowViewer for determining daily water levels over the expanded Subpopulation Ax. Regular reporting on this metric will be included in the Periodic Science Calls.

4) Upon locating a dead, injured, or sick specimen of any threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office (U.S. Fish and Wildlife Service, 9549 Koger Boulevard, Suite 111, St. Petersburg, Florida 33702; 727-570-5398). Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission, South Region, 3900 Drane Field Road, Lakeland, Florida, 33811-1299; 1-800-282-8002. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Service Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

5) The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918 as amended (16 USC Section 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 USC Section 668-668d), if such take is in compliance with the terms and conditions specified herein.

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use 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 further minimize or avoid adverse effects of a proposed action on federally listed species or critical habitat, to help implement recovery plans, or to develop information.

1) Continue to monitor the series of existing hydrological gauges to measure hydrologic impacts within the ERTP-2016 project area.

2) In cooperation with the Service and other parties, continue to explore ways to increase the outlet capacity of WCA-3A and WCA-3B via the S-333 and S-355 structures, as authorized and envisioned as part of the MWD and CEPP projects to benefit listed species. Improved capacity can be achieved by improving the S-355 and adding permanent pumps and/or by implementing the S-361, S-632, and S-633 structures proposed under CEPP. In the immediate future this connectivity could be maintained by using pumps, or some other structures, at the S-355 location to increase water releases from WCA-3B, as appropriate.

3) In cooperation with the Service and collaborating researchers, provide technical assistance to develop methods to restore marl prairie vegetation that has been impacted by high water levels.

4) In cooperation with the Service, collaborating researchers and other partners, support the development and application of real-time models to better inform snail kite-related water recommendations in the Everglades by meeting the following objectives:
    a. Develop spatially-explicit hydrologic relationships for snail kite reproductive responses, and adapt an existing snail kite population model (EverKite) to be run in real-time and near-term forecasts.
    b. Adapt the existing Florida apple snail model (EverSnail) to a real-time/ forecast application.
    c. Code models for online dissemination of software that runs the new models.
    d. Integrate snail kite and apple snail model outputs into a broader multi-species decision support framework.

5) In cooperation with DOI, ENP, USGS and the Service, engage in conservation activities as outlined in the DOI MOU for Cape Sable seaside sparrow.

6) Fund rangewide snail kite monitoring under section 7(a)(1) of the ESA to ensure that robust population estimates continue to be obtained and available to inform proposed projects and management activities conducted by the Corps and other agencies, as well as to inform recovery actions and evaluate progress toward meeting recovery criteria. A unified funding approach would also help ensure that data are collected in a seamless way and that the scientific integrity of the monitoring is maintained, and would increase monitoring efficiencies to leverage limited resources.

7) In cooperation with the Service, collaborating researchers and other partners, develop and implement an apple snail monitoring program across the range of the Everglade snail kite in Florida.

8) Investigate the potential for automating the S-12A and S-12B structures. Automating the S-12A/B would allow for more rapid responses to changes in conditions in WCA-3A and CSSS-A. If this is feasible then modify the structures as appropriate.

9) The completion of the following ongoing projects is necessary for the implementation of Increment 2 to allow for improved operational capacity along the eastern boundary of ENP and provide benefits to the eastern subpopulations.
    a. The C-111 South Dade North Detention Area western levee (L-315), North Detention Area eastern levee (L-316), L-357W levee extension to Richmond Drive, three ACBM weirs along the new segment of L-316 levee and the L-318 internal flowway berm in the North Detention Area including the S-318 weir on L-318 are currently scheduled for the completion in December 2017. The construction should be complete and initiate operational testing of these features begun prior to the start of the 2018 CSSS breeding season (March 1, 2018).
    b. The L-360W and L-360E internal flowway berms in the 8.5 SMA Detention Cell, Richmond Drive L-357W road crossing and S-360W weir/L-359 levee degrade are currently scheduled to be complete by December 2017. The construction should be complete and initiate operational testing of these features begun prior to the start of the 2018 CSSS breeding season (March 1, 2018).
    c. The construction of the 8.5 SMA S-357N Control Structure should be completed and operational testing initiated prior to the start of the 2017 wet season (May 31, 2017).

10) In addition to those actions mentioned above, the Service feels that the Corps should exercise their capabilities as outlined under section 7(a)(1) of the Endangered Species Act. The Service, in cooperation with our DOI partners, has developed an MOU outlining a variety of actions that we feel would provide benefits to the CSSS in the near term. We would welcome the Corps' active participation in the activities outlined in the MOU.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

10. REINITIATION NOTICE

This concludes formal consultation on the action outlined in the Corps' supplemental BA on ERTP-2016; however, the Corps is required to notify the Service of its final decision on the implementation of the RPA. As provided in 50 CFR Section 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 incidental take is exceeded;
2) 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;
3) 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; or
4) a new species is listed or critical habitat designated that may be affected by the action.

Measures of anticipated incidental take relative to criterion #1 above are provided in sections 8.1.1, 8.1.2, and 8.1.3, for the CSSS, Everglade snail kite, and wood stork, respectively. Specific instructions for monitoring and reporting the CSSS measures are provided in section 8.5, for the kite in section 8.4.1, and for the wood stork in section 8.4.2.

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12. TABLES

Table 1: CSSS Helicopter Survey Bird Count and Population Estimates 1981-2015. Population estimate fluctuation from ERTP Reinitiation Trigger (2001-2009 Ave. - 1 Std. Dev. Or 3,145 - 230 = 2,915) is shown in final column with exceedances in red.

Population Year	A		B		C		D		E		F		Total		
	BC	Est	BC	Est	BC	Est	BC	Est	BC	Est	BC	Est	BC	Est	Δ ERTP Trig.
1981	168	2,688	147	2,352	27	432	25	400	42	672	7	112	416	6,656	3,741
1992	163	2,608	199	3,184	3	48	7	112	37	592	2	32	411	6,576	3,661
1993	27	432	154	2,464	0	0	6	96	20	320	0	0	207	3,312	397
1994*	5	80	139	2,224	NS	NS	NS	NS	7	112	NS	NS	151	2,416	-499
1995	15	240	133	2,128	0	0	0	0	22	352	0	0	170	2,720	-195
1996	24	384	118	1,888	3	48	5	80	13	208	1	16	164	2,624	-291
1997	17	272	177	2,832	3	48	3	48	52	832	1	16	253	4,048	1,133
1998	12	192	113	1,808	5	80	3	48	57	912	1	16	191	3,056	141
1999a	25	400	128	2,048	9	144	11	176	48	768	1	16	222	3,552	637
1999b	12	192	171	2,736	4	64	NS	NS	60	960	0	0	247	3,952	1,037
2000a	28	448	114	1,824	7	112	4	64	65	1,040	0	0	218	3,488	573
2000b	25	400	153	2,448	4	64	1	16	44	704	7	112	234	3,744	829
2001	8	128	133	2,128	6	96	2	32	53	848	2	32	204	3,264	349
2002	6	96	119	1,904	7	112	0	0	36	576	1	16	169	2,704	-211
2003	8	128	148	2,368	6	96	0	0	37	592	2	32	201	3,216	301
2004	1	16	174	2,784	8	128	0	0	40	640	1	16	224	3,584	669
2005	5	80	142	2,272	5	80	3	48	36	576	2	32	193	3,088	173
2006	7	112	130	2,080	10	160	0	0	44	704	2	32	193	3,088	173
2007	4	64	157	2,512	3	48	0	0	35	560	0	0	199	3,184	269
2008	7	112	NS	2,512	3	48	1	16	23	368	0	0	34	3,056	141
2009	6	96	NS	2,512	3	48	2	32	27	432	0	0	38	3,120	205
2010	8	128	119	1,904	2	32	4	64	57	912	1	16	191	3,056	141
2011	11	176	NS	1,904	11	176	1	16	37	592	2	32	62	2,896	-19
2012	21	336	NS	1,904	6	96	14	224	46	736	4	64	91	3,360	445
2013	18	288	112	1,792	8	128	1	16	45	720	1	16	185	2,960	45
2014	4	64	114	1,864	7	112	2	32	42	672	1	16	170	2,720	-195
2015	13	208	120	1,920	7	112	4	64	55	880	2	32	201	3,216	301

NS = Not Surveyed

Includes Subpopulation B most recently conducted survey data for years not surveyed

Table 2: CSSS Habitat Western Marl Prairie Reinitiation Trigger: Fewer than 60 consecutive days with water levels below ground surface at NP-205 between March 1 and July 15 due to water releases in 2 consecutive years. Red shaded numbers illustrate non-compliance with the 60 day criteria and illustrate theoretical compliance with less than 80 and 90 day criteria.

	# Consecutive Days Stage @NP205 <6.01, 3/1-7/15				
	< 60		< 80		<90
1990	86		86		86
1991	75		75		75
1992	52		52		52
1993	0		0		0
1994	26		26		26
1995	0		0		0
1996	31		31		31
1997	6		6		6
1998	73		73		73
1999	61		61		61
2000	44		44		44
2001	95		95		95
2002	69		69		69
2003	24		24		24
2004	79		79		79
2005	46		46		46
2006	113		113		113
2007	25		25		25
2008	122		122		122
2009	79		79		79
2010	50		50		50
2011	117		117		117
2012	65		65		65
2013	60		60		60
2014	84		84		84
2015	120		120		120
Ave.	62				

Table 3: NP-205 Stage (NGVD29) ft. 6.0 ± 0.05, compared to % dry habitat in CSSS-A based on Sparrow Viewer Tool data, 1990 to 2015.

	NP205 Stage		% Habitat Dry
	NAVD88	NGVD29	
6/17/1990	4.52	6.02	
10/4/1990	4.5	6	
11/2/1990	4.5	6	
12/27/1991	4.52	6.02	22.5
1/8/1992	4.5	6	29.1
4/22/1992	4.54	6.04	46.5
5/3/1992	4.5	6	72.1
6/11/1992	4.54	6.04	16.2
5/5/1994	4.49	5.99	31.3
6/8/1994	4.51	6.01	12
4/21/1996	4.49	5.99	28.4
2/19/1997	4.54	6.04	17
3/9/1997	4.49	5.99	25.6
4/6/1997	4.51	6.01	38.1
4/23/1997	4.53	6.03	35.8
4/24/1998	4.54	6.04	11.5
7/20/1998	4.51	6.01	11
3/20/1999	4.5	6	21.3
5/29/1999	4.55	6.05	25.3
3/5/2000	4.52	6.02	11.2
4/18/2000	4.5	6	18.2
4/26/2000	4.5	6	25.1
8/29/2000	4.52	6.02	14.5
12/9/2000	4.54	6.04	11.3
1/1/2001	4.52	6.02	15.8
6/15/2001	4.53	6.03	32.2
7/4/2001	4.51	6.01	23.2
2/1/2002	4.51	6.01	20.5
3/14/2002	4.5	6	31.6
1/23/2003	4.52	6.02	21.4
4/4/2003	4.52	6.02	58.6
4/28/2003	4.5	6	38.5
4/30/2003	4.51	6.01	36.7
3/18/2004	4.51	6.01	20.2
6/21/2004	4.52	6.02	41.9
7/1/2004	4.51	6.01	45.5

Table 3: (continued) NP-205 Stage (NGVD29) ft. 6.0 ± 0.05, compared to % dry habitat in CSSS-A based on Sparrow Viewer Tool data, 1990 to 2015. Final row shows average stage (6.0) and % habitat (24.2) for the period of record analyzed.

1/11/2005	4.5	6	12
4/17/2005	4.5	6	48.5
3/12/2006	4.5	6	14
1/13/2007	4.51	6.01	21.1
2/9/2007	4.51	6.01	22.3
3/5/2007	4.52	6.02	30.6
3/30/2007	4.5	6	39.9
4/29/2007	4.51	6.01	29.6
12/8/2007	4.51	6.01	23.4
7/1/2008	4.54	6.04	15.4
1/29/2009	4.52	6.02	12.2
1/30/2009	4.5	6	12.5
2/21/2010	4.5	6	26.5
3/6/2010	4.49	5.99	30.7
5/10/2010	4.53	6.03	17
5/11/2010	4.48	5.98	19.1
6/29/2010	4.5	6	16.1
12/20/2010	4.52	6.02	11.9
12/21/2010	4.5	6	12.1
1/19/2012	4.52	6.02	12.1
1/20/2012	4.5	6	12.6
5/14/2012	4.52	6.02	30.6
5/15/2012	4.5	6	30.6
2/3/2013	4.51	6.01	11.2
5/27/2013	4.52	6.02	17.7
5/28/2013	4.49	5.99	16
3/3/2014	4.52	6.02	16.2
3/4/2014	4.48	5.98	17.8
4/2/2014	4.53	6.03	28.2
4/3/2014	4.5	6	30.1
6/25/2014	4.5	6	28.9
12/21/2014	4.5	6	11.5
12/22/2014	4.5	6	11.6
12/25/2014	4.51	6.01	11.5
1/31/2015	4.5	6	22.2
6/28/2015	4.49	5.99	29.6
7/19/2015	4.51	6.01	28.4
	4.5	6.0	24.2

Table 4: NP-205 Stage (NGVD29) ft., compared to 40% dry habitat ± 2%, in CSSS-A based on Sparrow Viewer Tool data, 1990 to 2015.

	% Dry CSSS-A	NP205 NGVD29
1/21/1992	40.7	5.58
2/4/1992	39.3	5.43
2/13/1992	40.6	5.4
4/26/1992	39.9	6.39
4/15/1994	40.6	6.32
4/19/1994	40.4	6.26
5/1/1994	39.7	6.06
5/2/1994	40.7	5.99
5/7/1994	39.9	5.76
4/27/1996	40.2	5.45
5/3/1996	40.1	5.37
4/7/1997	40.7	5.95
5/16/1997	39.8	6.16
5/14/1998	38.9	4.93
5/15/1998	41.4	4.85
6/5/1998	39.3	5.47
6/26/1998	40.1	5.26
6/27/1998	39	5.31
4/1/1999	39.9	5.16
4/6/1999	40.9	5.04
4/3/2000	39.3	4.41
4/4/2000	40.5	4.35
5/3/2000	40.8	5.19
6/4/2000	40	4.81
6/5/2000	39.2	4.78
6/7/2000	39.6	4.72
2/4/2001	39.8	5.13
2/5/2001	40.7	5.1
3/18/2002	39.8	5.72
5/30/2002	40.9	6.26
2/10/2003	39.8	5.38
3/20/2003	39.3	6.16
3/22/2003	40.5	6.26
3/29/2003	39.2	6.22
4/29/2003	39.6	5.98
5/13/2003	39.2	6.11

Table 4: (continued) NP-205 Stage (NGVD29) ft., compared to 40% dry habitat ± 2%, in CSSS-A based on Sparrow Viewer Tool data, 1990 to 2015. Final row shows average stage (5.41) and % habitat (40.1) for the period of record analyzed.

4/2/2004	40.2	5.04
4/13/2004	40.6	5.13
6/16/2004	41	6.23
6/19/2004	39.4	6.11
6/20/2004	40.4	6.07
2/17/2005	40	4.88
2/18/2005	40.9	4.84
3/10/2005	40.4	5.42
3/27/2005	40.8	5.56
3/31/2006	39.5	4.91
4/1/2006	40.6	4.84
6/18/2006	39.6	5.63
6/21/2006	40.4	5.54
3/10/2007	39.5	5.82
3/30/2007	39.9	6
5/19/2007	40.4	5.55
5/20/2007	39.8	5.63
1/3/2008	40.5	5.41
4/20/2008	39.4	5.58
4/21/2008	40.7	5.53
2/27/2009	39.3	4.9
2/28/2009	40	4.85
3/20/2010	40	5.64
4/3/2010	40.2	5.67
5/24/2010	40.1	5.01
5/28/2010	40.6	4.95
2/21/2011	39.8	5.07
2/22/2011	40.6	5.03
2/28/2012	39.2	5.01
2/29/2012	40.6	4.96
4/28/2012	40.2	4.75
3/14/2013	39.1	4.9
3/15/2013	40.4	4.84
4/7/2014	39.2	5.74
4/8/2014	40.9	5.68
4/23/2014	40.5	5.36
3/8/2015	39.7	4.96
3/9/2015	40.1	4.94
4/29/2015	39.2	5.3
5/4/2015	40.7	5.39
Average	**40.1**	**5.41**

Table 5: Discontinuous hydroperiod by calendar year (target 90-210 days/year) based on water level gauge readings in CSSS subpopulation A, 1992 – 2015. Color code categorizes conditions 0 – 89 days (red), 90 – 210 days (green), >210 – 240 days (blue green) and >240 days (blue). The average discontinuous hydroperiod across all gauges over the 1992 – 2014 period of record is 289 days.

	NP205	TMC	P34	BCA20	Ave.
1992	224	224	199	351	250
1993	366	329	366	366	357
1994	337	320	246	340	311
1995	366	366	366	366	366
1996	335	309	338	350	333
1997	353	273	312	346	321
1998	290	312	309	338	312
1999	305	305	295	342	312
2000	279	311	329	335	314
2001	212	218	232	253	229
2002	275	260	253	320	277
2003	288	245	247	366	287
2004	276	245	272	344	284
2005	233	247	252	322	264
2006	249	268	272	296	271
2007	239	208	320	334	275
2008	184	200	256	292	233
2009	257	279	277	294	277
2010	268	270	261	357	289
2011	189	230	235	250	226
2012	258	291	284	291	281
2013	280	313	316	324	308
2014	251	259	277	288	269
2015	171	162	241	238	203

Table 6: CSSS subpopulation acreage in the 90-210 day range discontinuous hydroperiod based on Sparrow Viewer Tool, 1992-2015. Average % of total subpopulation acreage by year and subpopulation. Average over all years is shown for the 1992 to 2008 and 2009 to 2014 periods. Color shading of years characterizing years (wet, dry, ave.) is referenced in key. The maximum acreage within each subpopulation boundary is detailed in the final row.

	A	B	C	D	E	F		
	A Annual	B Annual	C Annual	D Annual	E Annual	F Annual		
Year	90 to 210	90 to 210	90 to 210	90 to 210	90 to 210	90 to 210	90 to 210	
	Acres	Acres	Acres	Acres	Acres	Acres	Total Ac.	Ac. % of Total
1992	13472	22204	685	4737	14982	0	56,079	38.7%
1993	120	10497	4437	5603	7702	372	28,730	19.8%
1994	1257	20369	6467	5517	16785	1630	52,025	35.9%
1995	0	12175	4027	609	1224	1392	19,427	13.4%
1996	60	10536	3374	5603	5877	575	26,024	18.0%
1997	1677	12019	6918	5870	6300	575	33,357	23.0%
1998	419	5385	2682	2128	3695	272	14,581	10.1%
1999	60	8624	6467	3133	6923	2274	27,480	19.0%
2000	4850	11043	7401	3603	6367	238	33,502	23.1%
2001	14849	25130	7368	8169	18120	713	74,351	51.3%
2002	3652	11551	6056	5260	5654	783	32,956	22.8%
2003	3712	9482	6539	2951	5855	3463	32,002	22.1%
2004	3054	13502	4783	4255	7413	545	33,552	23.2%
2005	2395	23257	7779	5603	12822	4885	56,741	39.2%
2006	5269	18418	789	5432	7346	0	37,254	25.7%
2007	10299	16194	2722	5645	7769	0	42,629	29.4%
2008	21017	22125	7707	7784	21148	4275	84,056	58.0%
2009	4012	13111	4679	1786	5432	2442	31,462	21.7%
2010	9041	10770	7087	2438	8771	4038	42,144	29.1%
2011	12574	16701	5130	6169	13334	203	54,112	37.4%
2012	4431	7765	1965	609	4007	3666	22,444	15.5%
2013	1916	8000	4647	1347	3940	4409	24,259	16.8%
2014	5988	7219	4711	1433	4742	1085	25,177	17.4%
2015	14123	16467	1683	5260	11487	0	49,020	33.8%
Ave. 1992-2008	5068	14854	5071	4818	9175	1294	40,279	27.8%
% of Subpop. Total Ac.	8.5%	38.1%	63.0%	45.1%	41.2%	26.1%	27.8%	
Ave. 2009-2015	7441	11433	4272	2720	7388	2263	35517	24.5%
% of Subpop. Total Ac.	12.4%	29.3%	53.0%	25.4%	33.2%	45.7%	24.5%	
Max. Acres Subpop.	**59,844**	**39,022**	**8,053**	**10,692**	**22,261**	**4,954**	**144,826**	**100.0%**

Year Characteristic
Dry
Average
Wet

Table 7: Discontinuous hydroperiod by calendar year (target 90-210 days/year) based on water level gauge readings in CSSS subpopulation B, 1992 – 2015. Color code categorizes conditions 0 – 89 days (red), 90 – 210 days (green), >210 – 240 days (blue green) and >240 days (blue). The average discontinuous hydroperiod across all gauges over the 1992 – 2014 period of record is 209 days.

	NP46	CY3	SP	CY2	DO1	DO2	P38	Ave.
1992	206	183	165	128	141	152	265	177
1993	262	188	134	145	163	177	365	205
1994	237	149	142	169	176	184	252	187
1995	302	267	249	209	227	256	365	268
1996	264	210	173	140	144	141	365	205
1997	253	221	215	189	195	196	358	232
1998	288	296	252	239	236	211	337	266
1999	272	255	207	196	196	192	322	234
2000	275	246	124	127	148	146	339	201
2001	184	174	162	147	152	145	239	172
2002	295	256	185	151	162	168	327	221
2003	294	276	222	211	205	189	359	251
2004	216	197	143	106	112	106	281	166
2005	205	201	177	113	163	153	322	191
2006	184	161	122	122	134	135	348	172
2007	212	205	120	159	171	163	342	196
2008	177	184	159	109	123	109	252	159
2009	243	239	210	194	197	182	309	225
2010	300	262	154	158	162	136	345	217
2011	202	187	125	140	143	129	262	170
2012	246	247	220	244	235	217	336	249
2013	286	267	228	237	219	181	365	255
2014	275	233	113	144	119	87	343	188
2015	206	199	120	143	148	136	343	185

Table 8: Discontinuous hydroperiod by calendar year (target 90-210 days/year) based on water level gauge readings in CSSS subpopulation C, 1992 – 2015. Color code categorizes conditions 0 – 89 days (red), 90 – 210 days (green), >210 – 240 days (blue green) and >240 days (blue). The average discontinuous hydroperiod across all gauges over the 1992 – 2014 period of record is 175 days.

	NTS10	R3110	NTS1	E112	NTS18	Ave.
1992	4	145	143	194	3	98
1993	0	204	153	349	0	141
1994	72	185	166	292	2	143
1995	141	272	246	305	2	193
1996	35	197	157	251	0	128
1997	106	208	180	224	4	144
1998	40	253	203	326	4	165
1999	114	236	240	266	36	178
2000	121	236	205	243	112	183
2001	146	182	173	181	115	159
2002	129	223	189	220	114	175
2003	199	241	250	252	182	225
2004	116	164	181	202	93	151
2005	195	214	221	224	197	210
2006	71	175	146	178	57	125
2007	64	190	153	177	66	130
2008	135	191	177	191	150	169
2009	163	246	239	243	221	222
2010	159	251	254	268	225	231
2011	105	184	169	180	129	153
2012	225	261	258	260	233	247
2013	202	264	250	264	221	240
2014	131	255	258	260	199	221
2015	60	154	163	188	106	134

Table 9: CSSS Subpopulation Acreage in 90-210 Day Range Discontinuous Hydroperiod based on Sparrow Viewer Tool, 1992-2015. Chart is color coded to illustrate target % of available habitat ranges by each subpopulation (key).

CSSS Habitat Acreage in 90 to 210 Day Disc. HP Target Range							
Total CH Ac.	59,844	39,022	8,053	10,692	22,261	4,954	144,826
Year	A	B	C	D	E	F	Total Ac.
1992	13,465	22,204	685	4,737	14,982	0	56,071
1993	120	10,497	4,437	5,603	7,702	372	28,730
1994	1,257	20,369	6,467	5,517	16,785	1,630	52,024
1995	0	12,175	4,027	609	1,224	1,392	19,427
1996	60	10,536	3,374	5,603	5,877	575	26,024
1997	1,676	12,019	6,918	5,870	6,300	575	33,356
1998	419	5,385	2,682	2,128	3,695	272	14,581
1999	60	8,624	6,467	3,133	6,923	2,274	27,480
1999	60	8,624	6,467	3,133	6,923	2,274	27,480
2000	4,847	11,043	7,401	3,603	6,367	238	33,499
2000	4,847	11,043	7,401	3,603	6,367	238	33,499
2001	14,841	25,130	7,368	8,169	18,120	713	74,342
2002	3,650	11,551	6,056	5,260	5,654	783	32,954
2003	3,710	9,482	6,539	2,951	5,855	3,463	32,000
2004	3,052	13,502	4,783	4,255	7,413	545	33,550
2005	2,394	23,257	7,779	5,603	12,822	4,885	56,740
2006	5,266	18,418	789	5,432	7,346	0	37,252
2007	10,293	16,194	2,722	5,645	7,769	0	42,624
2008	21,005	22,125	7,707	7,784	21,148	4,275	84,044
2009	4,010	13,111	4,679	1,786	5,432	2,442	31,459
2010	9,036	10,770	7,087	2,438	8,771	4,038	42,139
2011	12,567	16,701	5,130	6,169	13,334	203	54,105
2012	4,428	7,765	1,965	609	4,007	3,666	22,441
2013	1,915	8,000	4,647	1,347	3,940	4,409	24,258
2014	5,984	7,219	4,711	1,433	4,742	1,085	25,174
2015	14123	16467	1683	5260	11487	0	49,020
Ave.	5503	13547	4999	4141	8499	1552	38,241

Key	A	B	C	D	E	F	Total Ac.
<25							
≥ 25%	14,961	9,755	2,013	2,673	5,565	1,239	36,206
≥ 40%	23,938	15,609	3,221	4,277	8,904	1,982	57,930
≥ 60%	35,906	23,413	4,832	6,415	13,357	2,972	86,896

Table 10: Discontinuous hydroperiod by calendar year (target 90-210 days/year) based on water level gauge readings in CSSS subpopulation D, 1992 – 2015. Color code categorizes conditions 0 – 89 days (red), 90 – 210 days (green), >210 – 240 days (blue green) and >240 days (blue). The average discontinuous hydroperiod at EVER4 over the 1992 – 2014 period of record is 215 days.

	EVER4	CSSS-D1	CSSS-D2	CSSS-D3	Ave.
1992	115				
1993	183				
1994	229				
1995	304				
1996	212				
1997	210				
1998	292				
1999	260				
2000	243				
2001	172				
2002	187				
2003	225				
2004	190				
2005	207				
2006	147				
2007	206				
2008	193				
2009	241				
2010	285				
2011	204	40	115	249	152
2012	254	201	229	331	254
2013	249	192	204	345	248
2014	283	111	178	317	222
2015	195	62	98	304	165

Table 11: Discontinuous hydroperiod by calendar year (target 90-210 days/year) based on water level gauge readings in CSSS subpopulation E, 1992 – 2015. Color code categorizes conditions 0 – 89 days (red), 90 – 210 days (green), >210 – 240 days (blue green) and >240 days (blue). The average discontinuous hydroperiod across all gauges over the 1992 – 2014 period of record is 206 days.

	NP206	NP62	A13	CR3	CR2	NP44	Ave.
1992	159	187	109	95	54	87	115
1993	232	277	175	115	157	124	180
1994	232	150	135	131	147	139	156
1995	352	364	330	314	247	200	301
1996	301	326	237	207	159	78	218
1997	232	244	224	212	189	182	214
1998	294	308	275	242	192	139	242
1999	279	287	249	218	209	142	231
2000	288	287	203	197	150	127	209
2001	194	177	169	173	162	130	168
2002	275	311	246	223	192	115	227
2003	280	264	229	196	217	156	224
2004	235	236	215	203	182	91	194
2005	245	235	194	217	212	128	205
2006	259	284	137	138	125	113	176
2007	194	224	153	149	125	125	162
2008	199	195	184	185	169	96	171
2009	257	272	252	245	238	164	238
2010	299	287	220	218	211	105	223
2011	183	232	159	152	134	93	159
2012	281	301	246	250	238	196	252
2013	290	311	262	257	243	154	253
2014	278	288	220	239	217	47	215
2015	191	219	134	101	97	96	140

Table 12: Discontinuous hydroperiod by calendar year (target 90-210 days/year) based on water level gauge readings in CSSS subpopulation F, 1992 – 2015. Color code categorizes conditions 0 – 89 days (red), 90 – 210 days (green), >210 – 240 days (blue green) and >240 days (blue). Numbers in red font are averages calculated with the years of missing data (1990 – 2000) at the RG4 gauge. The average discontinuous hydroperiod across all gauges over the 1992 – 2014 period of record is 107 days.

	RG1	RG2	RG3	RG4	G3437	Ave.
1992	172	23	1		1	49
1993	253	57	0		4	79
1994	265	120	7		38	108
1995	362	218	0		49	157
1996	312	67	0		5	96
1997	234	52	0		6	73
1998	307	23	0		4	84
1999	281	148	12		25	117
2000	297	40	22		16	94
2001	173	65	60	107	21	85
2002	289	51	19	103	1	93
2003	302	216	112	232	165	205
2004	236	56	20	62	18	78
2005	240	193	156	47	169	161
2006	269	15	3	29	7	65
2007	195	0	3	53	7	52
2008	201	128	57	125	114	125
2009	249	95	28	199	13	117
2010	317	127	99	243	122	182
2011	165	47	1	83	27	65
2012	284	208	178	230	172	214
2013	280	183	103	213	130	182
2014	269	67	0	180	31	109
2015	198	28	15	84	14	68

Table 13: Cape Sable seaside sparrow sex ratios (M/F) in subpopulations based on intensive ground monitoring 2006-1015. Multiplier is calculated by adapting the standard population estimation equation; Bird Count X [2(1 male, 1 female) X 8 (spatial component)] = Population Estimate; by BC X [1/Mean Sex Ratio (Multiplier)] X 8 = Revised Population Estimate.

Summary of Annual Sex Ratio in CSSS Subpopulations (2006-2015)													
Pop	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Mean	SE	Multiplier
A	-	-	0.61	0.56	0.67	0.73	0.77	0.67	0.57	0.57	0.64	0.03	12.44
B	-	-	-	-	-	-	-	0.59	0.57	0.53	0.56	0.02	14.21
C	0.54	0.63	0.71	0.64	-	-	-	-	-	-	0.63	0.04	12.70
D	0.67	0.67	1.00	0.60	0.78	0.86	0.75	0.60	0.79	0.92	0.76	0.04	10.50
E	0.49	0.54	0.51	0.56	-	-	-	-	-	-	0.52	0.01	15.25
F	0.67	1.00	-	-	-	-	-	-	-	-	0.83	0.17	9.60

Table 14: Total population estimate with variable sex ratio (green) compared to total population estimate using the conventional 16X multiplier (pink). Red shaded numbers indicate exceedance of ERTP reinitiation trigger (2,915) estimated total population 2011-2015, and theoretically 1981-2010.

	Total Population Estimate with Variable Sex Ratio	Total Population Est. w/16 Multiplier	Δ Pop Est. w/Variable Sex Ratio Compared to w/16 Multiplier	% Change
1981	5492	6656	-1164	-17.5
1992	5551	6576	-1025	-15.6
1993	2892	3312	-420	-12.7
1994*	2144	2416	-272	-11.3
1995	2412	2720	-308	-11.3
1996	2274	2624	-350	-13.3
1997	3599	4048	-449	-11.1
1998	2729	3056	-327	-10.7
1999a	3101	3552	-451	-12.7
1999b	3545	3952	-407	-10.3
2000a	3090	3488	-398	-11.4
2000b	3285	3744	-459	-12.3
2001	2914	3264	-350	-10.7
2002	2413	2704	-291	-10.8
2003	2862	3216	-354	-11.0
2004	3206	3584	-378	-10.5
2005	2743	3088	-345	-11.2
2006	2752	3088	-336	-10.9
2007	2853	3184	-331	-10.4
2008	2717	3056	-339	-11.1
2009	2776	3120	-344	-11.0
2010	2737	3056	-319	-10.4
2011	2561	2896	-335	-11.6
2012	2915	3360	-445	-13.2
2013	2623	2960	-337	-11.4
2014	2430	2720	-290	-10.7
2015	2856	3216	-360	-11.2
Average 1981-2015			-414	-11.7
Average 1993-2015			-360	-11.3

* Subpopulations C, D, and F not surveyed

Table 15: Habitat acreage in target 90-210 day discontinuous hydroperiod range divided by CSSS population estimate by year and subpopulation)

Habitat Acreage in Target 90 to 210 Day Discontinuous Hydroperiod Range Divided by CSSS Population Estimate by Year and Subpopulation)							
	# Acres/Bird						
	A	B	C	D	E	F	Total
1992	5.2	7.0	14.3	42.3	25.3	0.0	8.5
1993	0.3	4.3		58.4	24.1		8.7
1994	15.7	9.2			149.9		
1995	0.0	5.7			3.5		7.1
1996	0.2	5.6	70.3	70.0	28.3	35.9	9.9
1997	6.2	4.2	144.1	122.3	7.6	35.9	8.2
1998	2.2	3.0	33.5	44.3	4.1	17.0	4.8
1999a	0.1	4.2	44.9	17.8	9.0	142.1	7.7
1999b	0.3	3.2	101.0		7.2		7.0
2000a	10.8	6.1	66.1	56.3	6.1		9.6
2000b	12.1	4.5	115.6	225.2	9.0	2.1	8.9
2001	115.9	11.8	76.8	255.3	21.4	22.3	22.8
2002	38.0	6.1	54.1		9.8	48.9	12.2
2003	29.0	4.0	68.1		9.9	108.2	10.0
2004	190.8	4.8	37.4		11.6	34.1	9.4
2005	29.9	10.2	97.2	116.7	22.3	152.6	18.4
2006	47.0	8.9	4.9		10.4		12.1
2007	160.8	6.4	56.7		13.9		13.4
2008	187.5		160.6	486.5	57.5		27.5
2009	41.8		97.5	55.8	12.6		10.1
2010	70.6	5.7	221.5	38.1	9.6	252.3	13.8
2011	71.4		29.1	385.6	22.5	6.3	18.7
2012	13.2		20.5	2.7	5.4	57.3	6.7
2013	6.6	4.5	36.3	84.2	5.5	275.6	8.2
2014	93.5	3.9	42.1	44.8	7.1	67.8	9.3
2015	67.9	8.6	15.0	82.2	13.1		15.2
Ave.	46.8	6.0	69.9	121.6	19.5	78.7	11.5

Table 16: Percent of acreage in 90-210 day range discontinuous hydroperiod range compared to total available habitat per CSSS subpopulation based on Sparrow Viewer tool. El Nino years 1997-1998 and 2002-2003. Chart is color coded to illustrate target % of total available habitat.

	CSSS Subpopulations						
El Nino Yr.	A	B	C	D	E	F	Total
1997	3	31	86	55	28	12	23
1998	0.7	14	33	20	17	5	10
2002	6	30	75	49	25	16	23
2003	6	24	81	28	26	70	22

Key
< 25%
≥ 25%
≥ 40%
≥ 60%

Table 17: CSSS-A, CSSS Critical Habitat Designation (*FR Vol. 72, 214*), PCE. Hydrologic Regime-Nesting Criteria. Water depth exceeding 7.9 in. (20 cm) > 30 days, 3/15-6/30, at a frequency of more than 2 out of every 10 years. Number of days, exceedances in red.

	NP205	TMC	P34	BCA20	BCA09	SPARO
1990	0	2	0	2	12	
1991	3	42	4	19	47	
1992	6	19	3	8	32	
1993	73	33	14	43	95	
1994	0	27	0	0	64	
1995	104	92	108	108	108	
1996	2	6	7	12	68	
1997	10	12	16	9	51	
1998	17	19	33	20	45	
1999	12	7	12	13	48	
2000	0	0	0	0	25	
2001	0	0	0	0	13	
2002	13	15	15	0	22	
2003	5	8	18	0	55	
2004	0	0	0	0	4	
2005	14	10	9	6	33	
2006	0	0	0	0	2	
2007	1	4	15	0	22	
2008	0	0	0	0	17	
2009	0	0	0	0	41	
2010	0	0	0	0	18	
2011	0	0	0	0	0	
2012	0	0	5	0	21	0
2013	5	13	30	0	66	5
2014	0	0	0	0	20	0
2015	0	0	0	0	0	0

Table 18: CSSS-C, CSSS Critical Habitat Designation (*FR Vol. 72, 214*), PCE. Hydrologic Regime-Nesting Criteria. Water depth exceeding 7.9 in. (20 cm) > 30 days, 3/15-6/30, at a frequency of more than 2 out of every 10 years. Number of days, exceedances in red.

	NTS10	R3110	NTS1	E112	NTS18
1990	0	0	0	0	0
1991	0	16	0	29	0
1992	0	7	6	10	0
1993	0	1	0	16	0
1994	0	0	0	11	0
1995	0	10	10	18	0
1996	0	25	11	32	0
1997	2	29	25	35	0
1998	0	0	0	33	0
1999	0	10	0	14	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	15	8	17	0
2003	0	25	31	33	0
2004	0	0	0	0	0
2005	0	13	23	25	1
2006	0	0	0	0	0
2007	0	17	9	17	0
2008	0	0	0	0	0
2009	0	31	22	31	0
2010	0	26	29	32	28
2011	0	0	0	0	0
2012	0	44	43	53	41
2013	0	33	33	35	30
2014	0	0	0	0	0
2015	0	0	0	0	0

Table 19: Percentage of total acreage within Cape Sable seaside sparrow delineated habitat (CSSS-A), and designated critical habitat (CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F), ≥ 90 days dry by year, 1992 to 2015. Data based on USGS Sparrow Viewer Model Output. http://sofia.usgs.gov/eden/csss/index.php#sum-tab

% of Subpopulation Acreage Within Defined Habitat Areas ≥ 90 Consecutive Days Dry							
	A	B	C	D	E	F	
Year	≥ 90	≥ 90	≥ 90	≥ 90	≥ 90	≥ 90	
1992	26%	91%	100%	81%	99%	100%	
1993	0%	60%	97%	59%	62%	100%	
1994	3%	73%	82%	23%	70%	100%	
1995	0%	45%	90%	20%	19%	99%	
1996	2%	42%	43%	34%	49%	86%	
1997	11%	55%	81%	71%	36%	100%	
1998	6%	48%	95%	18%	45%	100%	
1999	8%	71%	100%	72%	80%	100%	
2000	13%	74%	96%	40%	65%	100%	
2001	40%	100%	100%	89%	100%	100%	
2002	25%	62%	100%	69%	60%	100%	
2003	3%	26%	59%	18%	24%	9%	
2004	29%	93%	100%	84%	90%	100%	
2005	25%	83%	100%	56%	93%	100%	
2006	33%	44%	100%	57%	65%	100%	
2007	6%	36%	97%	19%	36%	100%	
2008	23%	70%	99%	20%	75%	100%	
2009	16%	67%	87%	20%	16%	100%	
2010	11%	59%	94%	23%	66%	59%	
2011	62%	100%	100%	94%	100%	100%	
2012	11%	23%	8%	1%	8%	37%	
2013	1%	13%	9%	2%	0%	100%	
2014	23%	69%	100%	46%	75%	100%	
2015	33%	31%	97%	5%	46%	100%	
1992-2015 Ave.	17%	60%	85%	42%	57%	91%	
2002-2015 Ave.	22%	55%	82%	37%	54%	86%	
Last 10 Ave.	22%	51%	79%	29%	49%	90%	
1992-2008 Ave.	15%	63%	91%	49%	63%	94%	
2009-2015 Ave.	22%	52%	71%	27%	44%	85%	B-F Ave. Δ
Δ	8%	-11%	-20%	-22%	-18%	-9%	-16%

Table 20: Number of active snail kite nests (total and successful) and fledglings rangewide from 2009 to 2014. Numbers are from raw data provided by Dr. Robert Fletcher on December 1, 2015 and include only active nests of known fate.

Year	Total Number of Active Nests	Number of Successful Nests	Number of Fledglings
2009	126	41	68
2010	168	45	72
2011	196	94	166
2012	244	75	104
2013	316	129	172
2014	281	121	172

Table 21: Number of active and successful snail kite nests, calculated nest success, number of young fledged, and general location (north-central [NC], central [C], and south [S]) of nesting within WCA- 3A from 1994 to 2015. Active nests are those with at least one egg laid; successful nests are those having at least one young fledged. Numbers for 1994-2001 are as reported in raw data provided by Dr. Wiley Kitchens and his research team on August 6, 2010 and include all observed active nests, including those of unknown fate. Numbers for 2002-2015 are from raw data provided by Dr. Robert Fletcher on December 1, 2015 and include only active nests of known fate. Numbers for 2015 should be considered preliminary until the final report for the 2015 nesting season is completed.

Year	Active Nests	Successful Nests	Apparent Nest Success	No. of Young Successfully Fledged	General Location of Nesting within WCA-3A
1994	41	19	0.46[1]	24	No location data
1995	66	21	0.32[1]	38	No location data
1996	79	35	0.44	63	S
1997	247	140	0.57	303	C-S
1998	221	84	0.38	176	NC-C-S
1999	70	14	0.20	19	C-S
2000	112	33	0.29[1]	56	NC-C-S
2001	0	0	NA	0	--
2002	55	18	0.33	29	S
2003	43	24	0.56	29	C-S
2004	32	17	0.53	27	C-S
2005	12	0	0	0	S
2006	55	12	0.22	13	C-S
2007	3	0	0	0	S
2008	0	0	NA	0	--
2009	8	1	0.13	2	C-S
2010	14	0	0	0	C-S
2011	15	7	0.47	7	S
2012	4	0	0	0	S
2013	36	12	0.33	14	C-S
2014	36	20	0.56	30	S
2015[2]	16	10	0.63	11	S

[1] Survey data during 1994, 1995, and 2000 include many nests with undetermined fate, some of which may have been successful. Thus, calculated estimates of nest success for these years are minimums which would increase if any nests of undetermined fate were actually successful.

[2] Preliminary data

Table 22: Comparison of estimated ground surface elevation (GSE), stage, and water depths at four gauges – 3AS3W1, W2, 3A-28 (also known as Site 65), and Site 64 – and the 3-gauge average (3AVG; average of Sites 63, 64, and 65) in WCA-3A. All estimates were derived from daily mean stage data and GSE data obtained from the Everglades Depth Estimation Network. GSEs were calculated using the averages of measurements taken in wet prairie habitat (for gauge W2) or the average of measurements taken in the both slough and ridge/sawgrass/emergent marsh (*i.e.*, an average of the averages) to represent the transition zone where wet prairie typically occurs. All elevations and stages are in NGVD 29.

Gauge	Estimated GSE* in Wet Prairie	Difference from 3AS3W1 Stage		Water Depth (ft) when 3AS3W1 Stage = 10.5 ft	
		Average	SD	Average	SD
3AS3W1	8.39	--	--	2.11	--
W2	7.61	0.16	0.13	2.51	0.08
3A-28	7.70	0.13	0.08	2.62	0.25
Site 64	8.81	-0.40	0.17	2.27	0.09
3AVG	8.50	-0.23	0.21	2.40	0.12

*GSEs were calculated using the averages of measurements taken in wet prairie habitat (for gauge W2) or the average of measurements taken in the both slough and ridge/sawgrass/emergent marsh (*i.e.*, an average of the averages) to represent the transition zone where wet prairie typically occurs. All elevations and stages are in NGVD 29.

Table 23: Wet season (WS[1]) maximum water levels and dates, duration of high water (> 10.5 ft NGVD), and subsequent January 1 stages at gauges 3AS3W1, 3A-28, and the 3AVG from 1992-2009. ND = no data for gauge 3AS3W1 prior to 2000; NA = not applicable (stage did not go above 10.5 ft during that year); M = missing data, with additional information provided in table footnotes.

	3AS3W1						3A-28 (Site 65)						3AVG[2]
Year	WS Max	Date of WS Max	1st Day WS stage >10.5 ft	Last day WS stage >10.5 ft	WS Duration >10.5 ft	Following Jan 1 stage	WS Max	Date of WS Max	1st Day WS stage >10.5 ft	Last day WS stage >10.5 ft	WS Duration >10.5 ft	Following Jan 1 stage	Following Jan 1 stage
1992	ND	ND	ND	ND	ND	ND	10.58	25-Sep	24-Sep	30-Sep	6	10.13	10.38
1993	ND	ND	ND	ND	ND	ND	10.49	17-Oct	NA	NA	0	9.87	10.04
1994	ND	ND	ND	ND	ND	ND	12.04	23-Dec	30-Sep	17-Mar	167	11.98	12.63
1995	ND	ND	ND	ND	ND	ND	11.87	21-Oct	25-Aug	5-Jan	130	10.55	10.97
1996	ND	ND	ND	ND	ND	ND	10.21	27-Aug	NA	NA	0	9.82	10.09
1997	ND	ND	ND	ND	ND	ND	10.75	30-Sep	28-Sep	14-Oct	16	10.5	10.87
1998	ND	ND	ND	ND	ND	ND	10.44	22-Oct	NA	NA	0	10.19	10.64
1999	ND	ND	ND	ND	ND	ND	11.9	7-Nov	21-Sep	14-Jan	113	10.78	11.12
2000	10.07	9-Oct	NA	NA	0	9.59	10.02	4-Oct	NA	NA	0	9.53	9.68
2001	10.82	9-Nov	19-Oct	5-Dec	46	10.29	10.72	8-Nov	22-Oct	28-Nov	36	10.23	10.45
2002	10.62	12-Sep	M[3]	23-Aug	23-29[3]	10.15	10.45	15-Sep	NA	NA	0	10.06	10.3
2003	11.16	30-Sep	2-Sep	25-Nov	83	10.04	11.04	30-Sep	13-Sep	18-Nov	65	9.92	10.26
2004	11.13	24-Oct	18-Sep	21-Nov	63	10.03	11.04	25-Oct	23-Sep	16-Nov	53	9.98	10.19
2005	11.25	2-Sep	M[4]	12-Dec	121-150[4]	10.16	11.15	4-Sep	9-Jul	8-Dec	149	10.09	10.46
2006	10.64	30-Sep	24-Sep	11-Oct	17	9.86	10.49	1-Oct	NA	NA	0	9.79	M[6]
2007	9.875	15-Nov	M[5]	M[5]	M[5]	9.56	9.84	3-Nov	NA	NA	0	9.49	[illegible]
2008	11.5	1-Oct	19-Aug	3-Dec	104	10.29	11.37	10-Oct	23-Aug	23-Nov	90	10.22	10.39
2009	10.47	1-Oct	NA	NA	0	9.96	10.28	29-Sep	NA	NA	0	9.9	10.16
Avg		7-Oct	16-Sep	22-Nov	65.3-70.3			7-Oct	5-Sep	24-Nov	82.5		

[1]For the purposes of this analysis, WS was defined as June 1 to December 31. During years in which the WS max occurred on multiple days, the date shown is the last day on which that water level occurred.

[2]Color coding of the January 1 stage at the 3AVG corresponds to whether the observed stage was within (green), above (blue), or below (red) the recommended water level range for snail kites and apple snails (9.7 to 10.3 ft) in the Service's MSTS.

[3]Gauge 3AS3W1 missing data Aug 9-14, 2002; stage on Aug 8 = 10.49 ft; stage on Aug 15 = 10.62 ft. Days >10.5 ft were not consecutive.

[4]Gauge 3AS3W1 missing data Jun 28-Aug 10, 2005; stage on Jun 27 = 10.02 ft; stage on Aug 11 = 11.25 ft.

[5]Gauge 3AS3W1 missing large amounts of data throughout year; maximum stage was likely higher and likely occurred in October or earlier in November.

[6]3AVG missing data for Jan 1, 2007; based on extrapolation from stages on Dec 23, 2006 and Jan 17, 2007, estimated Jan 1 stage was 9.86 ft.

Table 24: Snail kite Critical Habitat Units with acreage.

Critical Habitat Unit Description	Acres
St. Johns Reservoir, Indian River County	2,075
Cloud Lake and Strazzula Reservoirs, St. Lucie County	816
Western Lake Okeechobee, Glades and Hendry Counties	85,829
Loxahatchee NWR, Palm Beach County	140,108
WCA-2A, Palm Beach and Broward Counties	106,253
WCA-2B, Broward County	28,573
WCA-3A. Broward and Miami-Dade Counties	319,078
ENP, Miami-Dade County	158,903
Total	841,635

Table 25: Wood stork egg survival per nesting chronology phase.

Age	Percent Survival
Egg-laying to Day 14	80
Egg-laying to Day 28 (hatching)	70
Egg-laying to Day 42	62
Egg-laying to Day 56	56
Egg-laying to Day 79	50
Egg-laying to fledging	46

Table 26: Wood stork nesting data in southeastern United States.

YEAR	TOTAL		FLORIDA		GEORGIA		SOUTH CAROLINA		NORTH CAROLINA	
	Pairs	Colonies	Pairs	Colonies	Pairs	Colonies	Pairs	Colonies	Pairs	Colonies
1981	4,442	22	4,156	19	275	2	11	1		
1982	3,575	22	3,420	18	135	2	20	1		
1983	5,983	25	5,600	22	363	2	20	1		
1984	6,245	29	5,647	25	576	3	22	1		
1985	5,193	23	4,562	17	557	5	74	1		
1986	5,835	36	5,067	29	648	4	120	3		
1987			**		506	5	194	3		
1988			**		311	4	179	3		
1989			**		543	6	376	3		
1990			**		709	10	536	6		
1991	4,073	37	2,440	25	969	9	664	3		
1992			**		1,091	9	475	3		
1993	6,729	43	4,262	29	1,661	11	806	3		
1994	5,768	47	3,588	26	1,468	14	712	7		
1995	7,853	54	5,523	31	1,501	17	829	6		
1996			**		1,480	18	953	7		
1997	5,166	59	2,870	36	1,379	15	917	8		
1998			**		1,665	15	1,093	10		
1999	9,978	71	8,319	50	1,139	13	520	8		
2000			**		566	7	1,236	11		
2001	5,582	44	3,246	23	1,162	12	1,174	9		
2002	7,855	70	5,463	48	1,256	14	1,136	10		
2003	8,813	78	5,804	49	1,653	18	1,356	11		
2004	8,379	93	4,726	63	1,596	17	2,057	13		
2005	5,560	74	2,304	40	1,817	19	1,407	13	32	1
2006	11,279	82	7,216	48	1,928	21	2,010	13	125	1
2007	4,406	55	1,553	25	1,054	15	1,607	14	192	1
2008	6,118	73	1,838	31	2,292	25	1,839	16	149	1
2009	12,720	86	9,428	54	1,676	19	1,482	12	134	1
2010	8,149	94	3,828	51	2,708	28	1,393	14	220	1
2011	9,579	88	5,292	45	2,160	19	2,031	23	96	1
2012	8,452	77	4,539	39	1,905	17	1,827	19	181	2
2013	11,046	100	6,948	57	1,873	19	2,020	21	205	3
2014	11,238	105	5,511	58	2,942	22	2,501	23	284	3
2015	10,058	96	4,705	51	2,496	21	2,496	22	361	2

**Incomplete data set from Florida as all colonies are not surveyed every year.

Table 27: Total number of wood stork nesting pairs within the Everglades and Big Cypress Basins, 1996 to 2014. Note: *Data was retrieved from the South Florida Wading Bird Reports from 1996-2014.*

Year	Nesting Pairs	3-Year Running Average
1996	600	-
1997	445	-
1998	475	507
1999	4,549	1,823
2000	3,996	3,007
2001	2,681	3,742
2002	2,880	3,186
2003	2,386	2,649
2004	1,015	2,094
2005	634	1,345
2006	2,710	1,453
2007	770	1,371
2008	704	1,395
2009	6,452	2,642
2010	1,220	2,792
2011	2,131	3,268
2012	1,234	1,528
2013	3,059	2,141
2014	2,799	2,364
Average	**2,108**	**2,195**

Table 28: Number of wood stork nests in the ERTP-2016 Action Area as reported in the South Florida Wading Bird Reports from 2006 through 2015.

Colony Name	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Tamiami East 1 (ENP)	0	0	0	10	15	0	0	0	0	0
Tamiami East 2 (ENP)	0	0	0	20	30	0	0	0	0	0
Tamiami West (ENP)	400	75	0	1,300	350	400	120	400	300	75
Grossman Ridge (ENP)	0	0	0	60	0	0	0	0	0	0
Crossover (WCA-3A)	175	0	0	28	0	0	0	0	0	0
Jetport (WCA-3A)	0	0	0	1,167	0	0	0	43	60	0
Jetport South (WCA-3A)	0	0	0	238	0	350	0	463	400	0
3B Mud East (WCA-3B)	15	0	0	7	0	0	0	0	0	0
2B Melaleuca (WCA-2B)	0	0	0	0	0	0	0	0	0	0
Total Colonies	**590**	**75**	**0**	**2,830**	**395**	**750**	**120**	**906**	**760**	**75**

Table 29: Observed weekly recession rate from January 1 through June 1, 2013 based upon WCA-3AVG. Positive values indicate falling water, negative values indicate rising water.

Week Ending	Recession Rate (feet per week)	Week Ending	Recession Rate (feet per week)
7-Jan	0.06	24-Mar	0.04
14-Jan	0.07	31-Mar	0.12
21-Jan	0.05	7-Apr	0.08
28-Jan	0.08	14-Apr	0.05
3-Feb	0.04	21-Apr	-0.04
10-Feb	0.07	28-Apr	0.02
17-Feb	0.03	5-May	-0.28
24-Feb	0.05	12-May	0.04
3-Mar	0.06	19-May	0.06
10-Mar	0.08	26-May	0.05
17-Mar	0.10	2-Jun	0.16

FWS MSTS Recession Rate (feet per week)
< 0.17
> 0.07 but ≤ 0.17
Preferred 0.06-0.07
≥ -0.05 but < 0.06
< -0.05

Table 30: Observed weekly recession rate from January 1 through June 1, 2014 based upon WCA-3AVG. Positive values indicate falling water, negative values indicate rising water.

Week Ending	Recession Rate (feet per week)	Week Ending	Recession Rate (feet per week)
7-Jan	0.06	24-Mar	0.09
14-Jan	0.02	31-Mar	0.07
21-Jan	0.07	7-Apr	0.09
28-Jan	0.07	14-Apr	0.09
3-Feb	-0.09	21-Apr	-0.03
10-Feb	0.05	28-Apr	0.13
17-Feb	0.03	5-May	0.07
24-Feb	0.04	12-May	0.14
3-Mar	0.05	19-May	-0.05
10-Mar	0.04	26-May	0.14
17-Mar	0.09	2-Jun	-0.10

FWS MSTS Recession Rate (feet per week)
< 0.17
> 0.07 but ≤ 0.17
Preferred 0.06-0.07
≥ -0.05 but < 0.06
< -0.05

Table 31: Observed weekly recession rate from January 1 through June 1, 2015 based upon WCA-3AVG. Positive values indicate falling water, negative values indicate rising water.

Week Ending	Recession Rate (feet per week)	Week Ending	Recession Rate (feet per week)
7-Jan	0.05	25-Mar	0.10
14-Jan	-0.03	1-Apr	0.08
21-Jan	0.04	8-Apr	0.10
28-Jan	0.07	15-Apr	0.10
3-Feb	0.05	22-Apr	0.01
10-Feb	0.02	29-Apr	-0.08
17-Feb	0.06	6-May	0.08
24-Feb	0.06	13-May	0.06
4-Mar	0.04	20-May	0.10
11-Mar	0.02	27-May	0.00
18-Mar	0.08	3-Jun	0.08

FWS MSTS Recession Rate (feet per week)
< 0.17
> 0.07 but ≤ 0.17
Preferred 0.06-0.07
≥ -0.05 but < 0.06
< -0.05

Table 32: Acres of wetland impact within the wood stork action area permitted by the Corps from 2010 to 2014.

	Acres of Wetlands Impacts Permitted					
	FY10	**FY11**	**FY12**	**FY13**	**FY14**	**Total**
Broward	2.98	38.26	75.80	238.80	67.20	263.04
Collier	10.72	59.64	575.18	55.03	71.21	771.78
Miami-Dade	6,587.92	543.82	178.40	1,049.93	226.54	8486.61
Monroe	18.05	0.70	3.97	8.72	0.92	32.36
Totals	6,619.67	642.42	833.35	1352.48	365.87	9,813.79

Table 33: Structure Operations in South Miami-Dade County

In the table, the list of structures is color-coded in three groupings:

green	Structures on the L-28, and L-29 canals. Structures included are S-345, S-349, S-344, S-343A-B, S-12A-D, S-333, S-334, S-355, and S-356
blue	Structures on the L-30/L67 and part of the L-31 canals Structures included are S-337, S-151, S-335, S-338, G-211, S-173 & S-331P (COMBQ), S-176 and S-174
yellow	Structures on part of the L-31 canal and L-31W and C-111 canals Structures included are S-332A-D, S-357, S-332, S-175, S-200, S-199, S-177, S-18C, S-197 and S-332E

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
L-28	S-344	Special code Design Q=250 cfs 1) Closed Nov 1- Jul 14 2) flood control only	R1B, INCR1B, INCR2B & INCR2B2: Closed Oct 1-Jul 14 R2H, INCR1H, INCR2H & INCR2H2: Closed Oct 1-Aug 15
	S-343A-B	Special code Design Q= 200 cfs each 1) Closed Nov 1- Jul 14 2) flood control only	R1B, INCR1B, INCR2B & INCR2B2: Closed Oct 1-Jul 14 R2H, INCR1H, INCR2H & INCR2H2: Closed Oct 1-Aug 15
L-29	S-12A-D	S12A closed Nov 1 to Jul 14; S12B closed Jan 1 to Jul 14; S12C no closure dates; S12D no closure dates. Special code 1) S12s maximum effective capacity = S12A 1400 cfs S12B 1500 cfs S12C 1900 cfs S12D 2500 cfs 2) Each structure modeled individually. 3) Each Structure is a spillway 4) Flood Control only 5) Capacity further limited by regional water gradient relative to Site 65 (3A-28) gauge.	R1B, INCR1B, INCR2B & INCR2B2: S12A & S12B Closed Oct 1-Jul 14 R2H, INCR1H, INCR2H & INCR2H2: S12A & S12B Closed Oct 1-Aug 15
	S-333	Special code Design Q=1350 cfs 1) L-29 stage constraint of 7.5 Wet/Dry 2) G-3273 stage constraint of 6.8 3) Flood Control only	R1B & R2H: same INCR1B & INCR1H: No G-3273 stage constraint When the WCA-3A stage is below the Increment 1 Action Line and stage at G-3273 is above 6.8': S-356 has limited priority over S-333 NCR2B, INCR2B2, INCR2H & INCR2H2: No G-3273 stage constraint L-29 stage constraint of 8.5 Wet/Dry INCR2B2 & & INCR2H2 Modified Rainfall Plan Environmental Target

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
L-29 Cont'd	S-334	Special code 1) Flood Control 2) No open/close ops, structure flow is restricted by L31N stage 3) Design Q=1230 cfs	R1B, R2H: same INCR1B, INCR2B, INCR2B2, , INCR1H, INCR2H & INCR2H2: When the WCA-3A stage is above the Increment 1 Action Line from 1 November through 14 July, S334 may be operated to deliver a portion of the WCA-3A regulatory releases to the SDCS under the following constraints: • When daily combined pumping at S-332B, S-332C, and S-332D is less than1,125 cfs, S-334 may be utilized up to a maximum flow rate of 250 cfs • When daily combined pumping at S-332B, S-332C, and S-332D is less than 1,000 cfs, S-334 may be utilized up to a maximum flow rate of 400 cfs
	S-355	Special code S355 A and B Modeled Design Q = 1000 cfs each, 1) L-29 stage constraint of 7.5 Wet/Dry 2) G-3273 stage constraint of 6.8 3) 3) Flood Control only	R1B & R2H: same INCR1B & INCR1H: No G-3273 stage constraint INCR2B, INCR2B2, INCR2H & INCR2H2: No G-3273 stage constraint L-29 stage constraint of 8.5 Wet/Dry
	S-356	Not Operated	R1B & R2H: same INCR1B, INCR2B, INCR2B2, INCR1H, INCR2H & INCR2H2: Special code **5.8 / 5.5** open/closed wet & dry season subject to: 1) When the WCA-3A stage is above the Increment 1 Action Line: S-356 is not operated 2) When the WCA-3A stage is below the Increment 1 Action Line and stage at G- 3273 is above 6.8': S-356 has limited priority over S-333 3) When the WCA-3A stage is below the Increment 1 Action Line and stage at G- 3273 is below 6.8': S-356 use is secondary to S-333
L-30/ L-67	S337	1) Water Supply / Flood Control 2) Design Q=1100 cfs (discharge coef = 1053 cfs) mse_unit inlet L30; L30 localLevel=7.0 mse_unit outlet C-304; C304 localLevel=99.0	R1B & R2H: same INCR1B, INCR2B, INCR2B2, INCR1H, INCR2H & INCR2H2: Water Supply only

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
L-30/ L-67 Cont'd	S-151	Special code Flow target based on WCA-3A regulation schedule 1) Water Supply / Flood Control 2) Design Q=1800 cfs (discharge coef. = 1154.48) mse_unit outlet for WCA-3A; "WCA3A local" localLevel = 7.5 mse_unit inlet C-304; C304 localLevel=99.0 Special Code for S151: S151_reg_max_zoneA=1000 S151_reg_max_zoneBC=500	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
	S-152	Not Operated	R1B, INCR1B, INCR2B, R2H, INCR1H & INCR2H: same INCR2B2 & INCR2H2: Special code Design Q = 400 cfs Operated to discharge target Tamiami Trail flows when Site 71 < 8.5 ft.
	S-335	**7.0/ 6.5** open/closed wet & dry season 1) Water Supply / Flood Control 2) Design Q=1170 (discharge coef. = 1468 cfs) 3) twHeadLimit = 6.0 mse_unit outlet for L30; L30 localLevel=7.0 mse_unit inlet for L31NC; localLevel=99.0	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
L-31N	S-338	Special code (Column 1/Column2 Ops) **5.8 / 5.5** open/close (Column 1) **5.8 / 5.4** open/close (Column 2) 1) Water Supply / Flood Control 2) Design Q=305 (discharge coef. = 393 cfs) mse_unit outlet for L31NC; L31NC localLevel=99.0 mse_unit inlet for C1; C1 maintLevel=3.0	R1B, INCR1B, INCR2B & INCR2B2: same R2H, INCR1H, INCR2H & INCR2H2: **5.3 / 4.9** open/close Flood Control only Feb 16-Jul 31 **5.4 / 5.0** open/close (Column 2) Note: Lowered operations at S-194 and S-196 structures (Feb 16-Jul 31) and Lowered Column 2 operations at S-194 and S-196 Structures

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
L-31N Cont'd	G-211	Special code (Column 1/Column2 Ops) **6.0 / 5.5** open/close (Column 1) **5.7 / 5.3** open/close (Column 1) twHeadLimit = 5.3 1) Water Supply / Flood Control 2) Design Q=1100 (discharge coef. = 943 cfs) mse_unit outlet for L31NC; L31NC localLevel=99.0 mse_unit inlet for L31N; L31N localLevel=99.0 no rulecurve	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
	S-173 & S-331P (COMBQ)	Special Code 1) Water Supply / Flood Control 2) Design Q=1161 mse_unit outlet for L31N; localLevel = 99.0 mse_unit inlet for L31S; "L31S maint" maintLevel = 3.0, "L31S res" resLevel = 2.5 S331_TW_lim = 6.0 Operations defined in S331_ECB_2010-11.cc: S331_HW_levels = 4.0 4.5 5.0 5.5 (LPG2 stage criteria) S331 OPERATING CRITERIA: "Discharges through S-331 can be made if the S-331 tailwater stage is below 6.0 feet and the S-176 headwater stage is below 5.5 feet. If either of those water levels of S-331 and S-176 were exceeded, discharges at S-331 would be terminated until the S-176 headwater recedes to 5.0 feet." S176_Cond is dependent on S331_TW and S176_HW -> true if either stage prohibits S-331 releases.	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
L-31N Cont'd	S-173 & S-331P (COMBQ) Cont'd	S331 High Range: If the water level at LPG2 well is < 5.5 ft, S331 HW will have no limit. S331 Intermediate Range: If the level at LPG2 well is > or = 5.5 and < 6.0 ft, the average daily water level upstream of the S-331 will be maintained between 5.0 ft., and 4.5 ft if permitted by d/s conditions. S331 Low Range: If the level at LPG2 well is > or = 6.0 ft and S-357 constraints are limiting the ability of maintaining C-357 avg daily WL below 6.2 ft, the average daily water level upstream of S-331 will be maintained between 4.5 ft. and 4.0 ft if permitted by d/s conditions. S331 Low Range Adjustment: If the level at LPG2 well is > or = 6.0 ft and S-357 constraints are not limiting the ability of maintaining C-357 avg daily WL below 6.2 ft, the average daily water level upstream of S-331 will be maintained between 4.5 ft. and 4.0 ft if permitted by d/s conditions. Use previous day LPG2 stage, S331_TW and S176_HW, C-357 WL for current day operations	
	S-176	Special code (Column 1/Column 2 Ops) **5.0 / 4.75** open/close (Column 1) **4.9 / 4.7** open/close (Column 2) 1) Water Supply / Flood Control 2) design Q = 1100 cfs (discharge coef. = 1135 cfs) mse_unit outlet for L31S; "L31S maint" maintLevel = 3.0; "L31S res" resLevel = 2.5 mse_unit inlet for C111; maintenance level and reserve level determined in high_rf_events assessor	R1B, INCR1B, INCR2B & INCR2B2: same R2H, INCR1H, INCR2H & INCR2H2: In addition to ECB16 operations: Release up to 200 cfs flood control based on **4.8 / 4.55** open/close criteria Sep 1- Dec 31
	S-174	S174 not in model; canal is blocked near structure	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
L-31N Cont'd	S-332B, C,D (pumps)	Ramp-up operations for each structure instead of Column 1 and Column 2 ops S332BN1 4.7/4.5 S332BN2 5.0/4.7 S332B1 4.7/4.5 S332B2 5.0/4.7 S332C1 4.7/4.5 S332C2 5.0/4.7 S332D1 4.65/4.5 S332D2 4.85/4.65	R1B, INCR1B, INCR2B & INCR2B2: same R2H, INCR1H, INCR2H & INCR2H2: Lower all S-332 operations by 0.5 ft (both open and close) Aug 1 to Dec 31 and transition back to ECB16 levels by Feb 15
L-31N Cont'd	S-332B, C,D (pumps) Cont'd	S332BN1 =125 cfs, TW Limit= 8.5 S332BN2 =125 cfs, TW Limit= 8.5 S332B1 = 125 cfs, TW Limit= 8.0 S332B2 = 125 cfs, TW Limit= 8.0 S332C1 = 250 cfs, TW Limit= 8.0 S332C2 = 250 cfs, TW Limit= 8.0 S332D1 = 250 cfs, TW Limit= 7.5 S332D2 = 250 cfs Jul15-Nov30, 75cfs Dec 1-Jan31, closed Feb 1-Jul14, TW Limit= 7.5 All Flood Control	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
	S-357 (pump)	**6.2 / 5.7** open/closed wet & dry season 1) Flood Control 2) Pump Q = 126 cfs mse_unit outlet for 8.5SMA_wcd; twHeadLimit = 12.17 Mse_unit inlet to 8.5SMA_STA	R1B, INCR1B, R2H & INCR1H: same INCR2B, INCR2B2, INCR2H & INCR2H2: Pump Q = 500 cfs S360W weir elevation is lowered to establish a flow thru 8.5 STA to Northern detention area
L-31W	S-332 (pumps)	Non-existent	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
	S-175	Non-existent	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
C-111	S-200	S-200A=75cfs; **3.6/3.4** S-200B=75cfs; **3.7/3.4** S-200C=75cfs; **3.8/3.4** TW Head Limit= 8.5 Closure Mar 15-Jun 30 if stages > 4.96 at R3110 location	R1B, INCR1B, INCR2B & INCR2B2: same R2H, INCR1H, INCR2H & INCR2H2: Lower all S-200 operations to **3.1/2.7** Aug 1 to Dec 31 and transition back to ECB levels by Feb 15
	S-199	S-199A=75cfs; **3.8/3.6** S-199B=75cfs; **3.9/3.6** S-199C=75cfs; **4.0/3.6** TW Head Limit= 8.0 Closure Mar 15-Jun 30 if stages > 2.41 at EVER4 location	R1B, INCR1B, INCR2B & INCR2B2: same R2H, INCR1H, INCR2H & INCR2H2: Lower all S-200 operations to **3.3/2.9** Aug 1 to Dec 31 and transition back to ECB levels by Feb 15

Canal	Structure	ECB16 (RSMGL)	Change Conditions for ERTP-2016 Scenarios
		Recommended for ECB Open/Close (ft NGVD) (Optimum stage ft NGVD) Wet Season/Dry Season Normal FC Operation	Green or no comment indicates same as ECB Yellow indicates operation per scenario Blue indicate operation per Increment 1 Grey indicates operation per "Increment 2"
C-111 Cont'd	S-177	Special Code Open/Close determined in high rainfall event Special Code. Dry season: **Medium to high rainfall : 4.2/3.6** open/close **High rainfall : 3.7/3.1 open/close** Wet season: **Medium to high rainfall : 3.7/3.1** open/close **High rainfall : 3.2/3.1 open/close** 1) Water Supply & Flood Control Spillway w/1 gate Design Q = 2900 cfs. Mse_unit outlet to C111 maint level and res level determined in high_rf_events assessor Mse_unit inlet to C111E, maintlevel=1.8; reslevel=1.5	R1B, INCR1B, INCR2B & INCR2B2: same R2H, INCR1H, INCR2H & INCR2H2: In addition to ECB16 operations: Release up to 200 cfs flood control based on **3.9 / 3.2** open/close criteria Sep 1- Dec 31
	S-18C	Special code (Column 1/Column2 Ops) **2.6 / 2.3** open/close (Column 1) **2.25 / 2.0** open/close (Column 2) 1) Water Supply (including minimum flows) & Flood control Spillway w/2 gates Design Q=3200 cfs. Mse_unit outlet for C111E; "C111E maint" maintlevel =1.8; "C111E res" reslevel =1.5	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same
	S-197*	Spillway w/4 gates Design Q= 6000 cfs. Flood control only S-197 Ops: 1) Level 1: S-177 HW > 4.10' or S-18C HW > 2.80' then open 2 gates by 3.7 feet (remaining gates closed) 2) Level 2: S-177 HW > 4.20' or S-18C HW > 3.10' then open 4 gates by 4.3 feet 3) 3) Level 3: S-177 HW > 4.30' or S-18C HW > 3.30' then open 4 gates by 10.0 feet	R1B & R2H: same INCR1B, INCR2B, INCR2B2, INCR1H, INCR2H & INCR2H2: Design Q=2400 cfs. ECB16 operations + when the WCA-3A stage is above the Increment 1 Action Line then S-197 Level 1 Discharge up to: S-178 TW (feet, NGVD) = S197 (cfs) 2.5 to 2.6 = 50 to 100 2.61 to 2.7 = 100 to 150 2.71 to 2.9 = 150 to 200 > 2.9 = 500
	S-332E (pump)	Non-existent	R1B, INCR1B, INCR2B, INCR2B2, R2H, INCR1H, INCR2H & INCR2H2: same

Note – In simulations, Dual Operations defined per:

ECB16, R1B, R2H – SDCS column 1 and column 2 operations per "ERTP 2012 Water Control Plan"

INCR1B, INCR2B, INCR2B2, INCR1H, INCR2H & INCR2H2 – SDCS column 1 and column 2 operations per "G-3273 Constraint Relaxation/S-356 Field Test and S-357N Operational Strategy"

Table 34: Number of years for the 1965 – 2005 period of record (41 years) that the discontinuous hydroperiod target (≥ 40% of habitat in the 90-210 day range), and the consecutive dry day (3/1 – 7/15, ≥ 40% of habitat ≥ 90 days) target is met for each subpopulation and modeled area. The existing condition base (ECB16) is compared to the illustrated modeled scenarios (INCR2B, INCR2H).

		90-210 Day Disc. Hydroperiod		
Scenario		**ECB16**	**INCR2B**	**INCR2H**
CSSS Subpopulation				
A		9	11	10
A (Expanded)		16	20	20
B		20	20	20
C		16	18	19
D		18	18	18
E		21	19	20
F		22	14	13

		≥90 Consecutive Dry Days		
Scenario		**ECB16**	**INCR2B**	**INCR2H**
CSSS Subpopulation				
A		16	18	19
A (Expanded)		21	25	25
B		37	37	37
C		36	36	36
D		18	18	20
E		30	26	26
F		32	30	31

Table 35: Annual difference in acres between the ECB16 (base) condition and the INCR2B (CSSS-A, CSSS-Ax) and INCR2H (CSSS-B, CSSS-C, CSSS-D, CSSS-E, CSSS-F) modeled scenarios in the 90-210 day discontinuous hydroperiod range for the 1965 – 2005 period of record for each CSSS subpopulation.

	Modelled Change From ECB16 Discontinuous Hydroperiod 90 - 210 Days						
	INCR2B-ECB16		INCR2H-ECB16				
Year	# Acres A	# Acres A exp.	# Acres B	# Acres C	# Acres D	# Acres E	# Acres F
1965	-197	-3,394	0	0	0	-159	0
1966	2,130	3,394	-314	-595	-587	-2,619	-495
1967	3,866	7,577	39	-119	-1,332	-1,627	572
1968	3,866	5,880	-118	-3,253	-1,097	-1,309	-1,524
1969	4,655	7,656	-196	198	-431	-2,460	-1,410
1970	1,341	2,999	-629	-1,785	-783	-2,738	-610
1971	-2,209	-3,907	-550	0	2,037	1,151	0
1972	-276	-474	-236	-278	-352	556	762
1973	-789	-2,605	-157	436	157	-278	267
1974	158	631	157	-40	940	-278	-76
1975	3,629	1,894	157	-40	940	-675	-114
1976	8,560	10,024	118	-2,301	-117	-1,429	-1,448
1977	-4,300	-6,867	314	952	392	2,579	2,134
1978	355	434	-118	-397	274	-754	-1,296
1979	2,012	2,802	-118	159	-1,175	119	-191
1980	-2,051	-1,381	-314	-159	-352	-2,143	-114
1981	0	1,223	0	0	235	833	0
1982	5,799	11,799	39	3,848	-1,292	-1,468	762
1983	1,657	2,210	-511	-1,111	-39	-992	-267
1984	2,051	4,972	-39	0	-1,919	-3,333	-1,029
1985	-3,077	-8,090	0	79	627	1,032	191
1986	4,458	7,814	-432	-555	-274	-3,016	-2,591
1987	-79	1,776	-314	0	2,702	1,587	457
1988	6,115	8,129	196	-79	-1,097	-635	-2,210
1989	-2,249	-2,999	275	0	1,175	1,706	457
1990	-197	237	39	0	0	40	0
1991	197	276	157	-476	-78	0	0
1992	2,840	6,275	118	278	-352	-3,809	-953
1993	4,655	8,327	-314	2,182	-1,097	-2,421	-1,181
1994	2,604	5,683	-1,258	3,689	-274	-2,579	-1,334
1995	0	0	-550	-198	-157	0	0
1996	1,894	3,631	-1,336	-674	-587	-1,905	-1,601
1997	5,286	9,668	314	238	-2,702	-4,722	-305
1998	2,683	4,499	118	952	-392	-556	-876
1999	2,446	3,828	-118	238	-1,410	-2,301	-838
2000	1,578	2,762	-314	5,792	-1,371	-1,786	991
2001	3,748	2,920	393	754	470	79	76
2002	4,063	6,867	-196	-79	-1,684	-3,690	-2,401
2003	276	-158	275	238	-2,546	-476	-114
2004	1,657	2,526	118	873	979	1,032	953
2005	9,981	9,708	118	0	-39	-238	-76
65-05 Ave.	1,930	2,891	-127	214	-308	-968	-376
65-05 Max.	9,981	11,799	393	5,792	2,702	2,579	2,134
65-05 Min.	-4,300	-8,090	-1,336	-3,253	-2,702	-4,722	-2,591
# yrs. Decrease	10	9	21	17	27	28	24
# yrs. Increase	29	31	17	16	12	11	11
92-05 Ave.	3,122	4,752	-188	1,020	-797	-1,669	-547

Table 36: Annual difference in acres between the ECB16 (base) condition and the INCR2B (CSSS-A, CSSS-Ax) and INCR2H (CSSS-B, CSSS-C, CSSS-D, CSSS-E, CSSS-F) modeled scenario in the March 1 to July 15, consecutive dry days ≥ 90 range for the 1965 – 2005 period of record for each CSSS subpopulation.

	Modelled Change From ECB16 Consecutive Dry ≥ 90 Days, 3/1-7/15						
	INCR2B-ECB16		INCR2H-ECB16				
Year	# Acres A	# Acres A exp.	# Acres B	# Acres C	# Acres D	# Acres E	# Acres F
1965	-197	-1,736	0	0	666	-436	0
1966	-473	-2,249	-118	0	1,214	-3,690	-191
1967	3,195	2,644	39	0	78	-556	0
1968	39	79	-39	40	0	0	0
1969	1,539	4,459	-275	1,190	1,018	-2,698	76
1970	2,209	5,327	-1,022	-238	-1,097	-3,055	-343
1971	39	39	0	0	0	0	0
1972	0	-513	0	0	0	0	1,258
1973	-39	-434	-196	0	-39	-436	0
1974	0	0	0	0	0	0	0
1975	394	434	39	0	157	0	0
1976	710	1,144	-39	0	0	-278	0
1977	158	158	-236	-198	-39	-556	0
1978	-434	-2,881	-39	159	431	357	0
1979	3,669	4,065	-432	516	39	-1,984	0
1980	39	2,723	-314	79	2,311	-3,016	-191
1981	-158	-158	0	0	-39	0	0
1982	513	789	0	0	0	-278	38
1983	158	750	-432	-1,190	-39	-595	0
1984	3,393	4,499	-275	516	157	-913	114
1985	79	79	-79	0	0	0	0
1986	5,483	11,168	-432	595	822	-2,976	152
1987	5,483	8,998	-393	198	1,802	-1,667	38
1988	4,182	3,433	432	0	744	-2,817	0
1989	0	0	0	0	0	0	0
1990	-79	-158	0	0	-196	0	0
1991	-39	-197	39	159	78	0	114
1992	1,617	-158	39	0	1,253	-2,778	0
1993	6,982	13,417	-904	0	-509	-5,397	-2,363
1994	5,602	10,931	-1,297	635	117	-4,206	2,744
1995	0	395	-1,022	-1,388	-157	-516	0
1996	2,051	2,881	-236	238	666	-3,135	-305
1997	2,998	2,960	0	0	0	-317	0
1998	5,128	9,432	-1,022	-79	-196	-4,405	-1,296
1999	2,959	4,380	39	0	-39	-2,936	-114
2000	1,183	2,328	-157	0	-39	-4,603	0
2001	118	118	0	0	78	0	0
2002	1,420	-474	0	0	1,410	-2,778	0
2003	473	316	-236	0	117	-1,429	0
2004	394	434	0	0	0	0	0
2005	907	908	0	0	0	0	0
65-05 Ave.	1,505	2,203	-209	30	263	-1,417	-7
65-05 Max.	6,982	13,417	432	1,190	2,311	357	2,744
65-05 Min.	-473	-2,881	-1,297	-1,388	-1,097	-5,397	-2,363
# yrs. Decrease	7	10	22	5	11	27	7
# yrs. Increase	30	29	6	11	19	1	8
92-05 Ave.	2,274	3,419	-342	-43	193	-2,321	-95

Table 37: CSSS critical habitat PCE 4: Hydrologic Regime–Nesting Criteria. Water depth does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years. INCR2B and INCR2H effects modeled for subpopulations. Average % habitat exceeding the criterion over the 1965 – 2005 period of record; number of years the criterion is exceeded; and frequency the criterion is exceeded (i.e. 2 out of 10 years = 0.2)

Water Depth ≥ 20 cm ≥ 30 days consecutive (Frequency more than 2 out of 10 years (> 0.2))							
	INCR2B		INCR2H				
	CSSS-A	CSSS-A exp.	CSSS-B	CSSS-C	CSSS-D	CSSS-E	CSSS-F
Ave. %	7	6	1	0	1	4	1
# yrs. > 0	30	30	8	1	20	11	6
Frequency	0.73	0.73	0.20	0.02	0.49	0.27	0.15

13. FIGURES

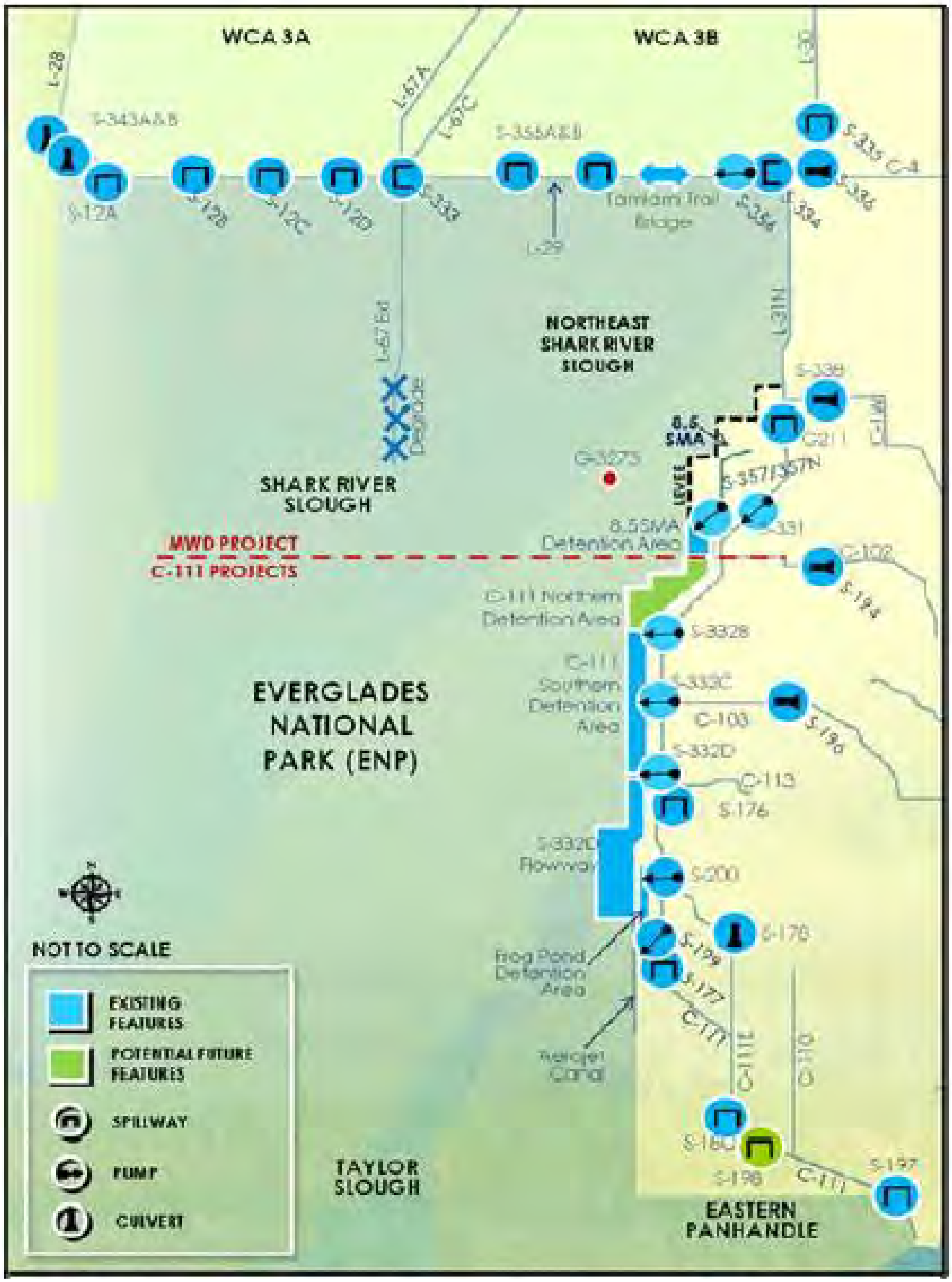


Figure 1: Project location and the major project components of the MWD and C-111 Projects

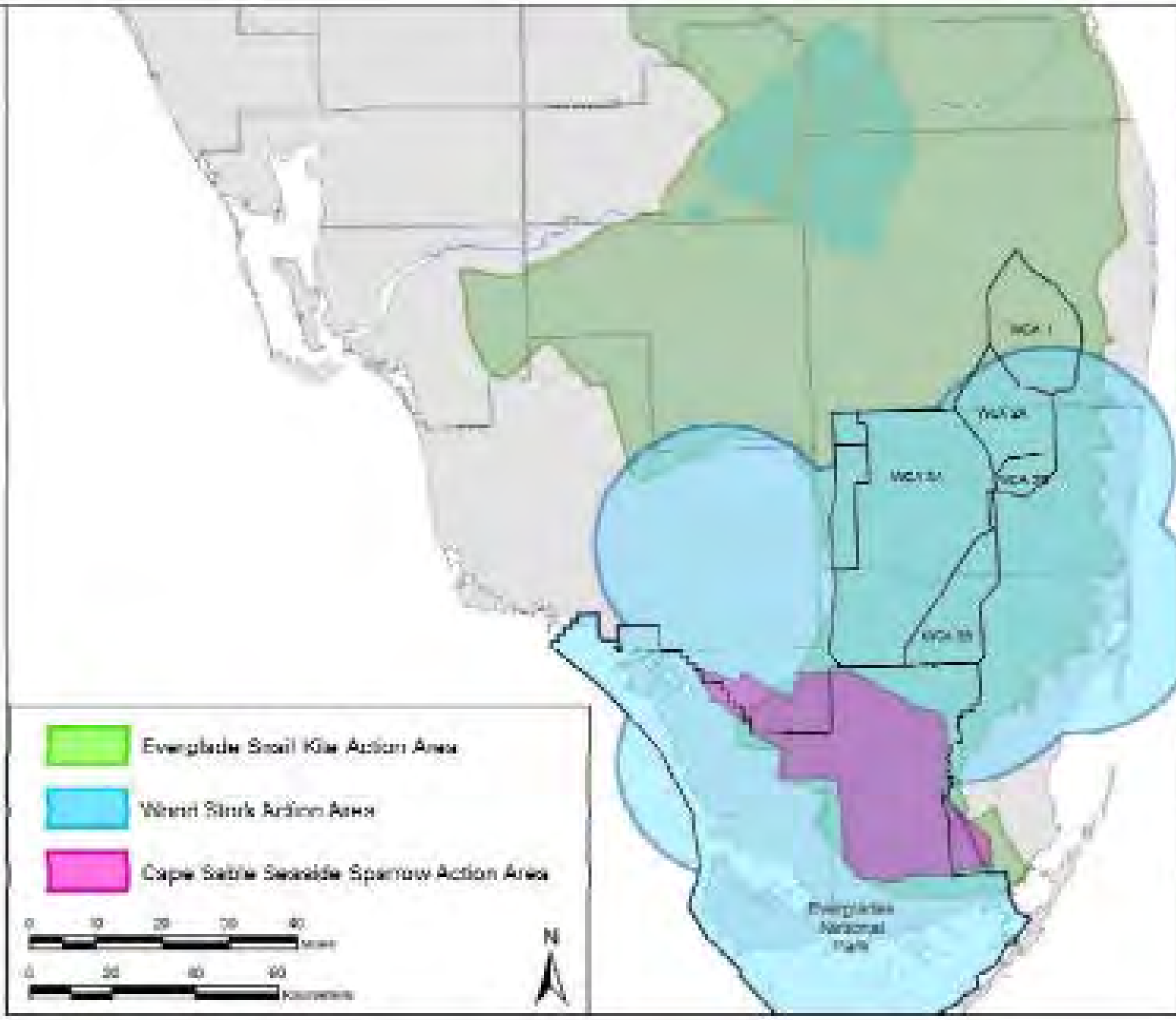


Figure 2: ERTP-2016 Action Area

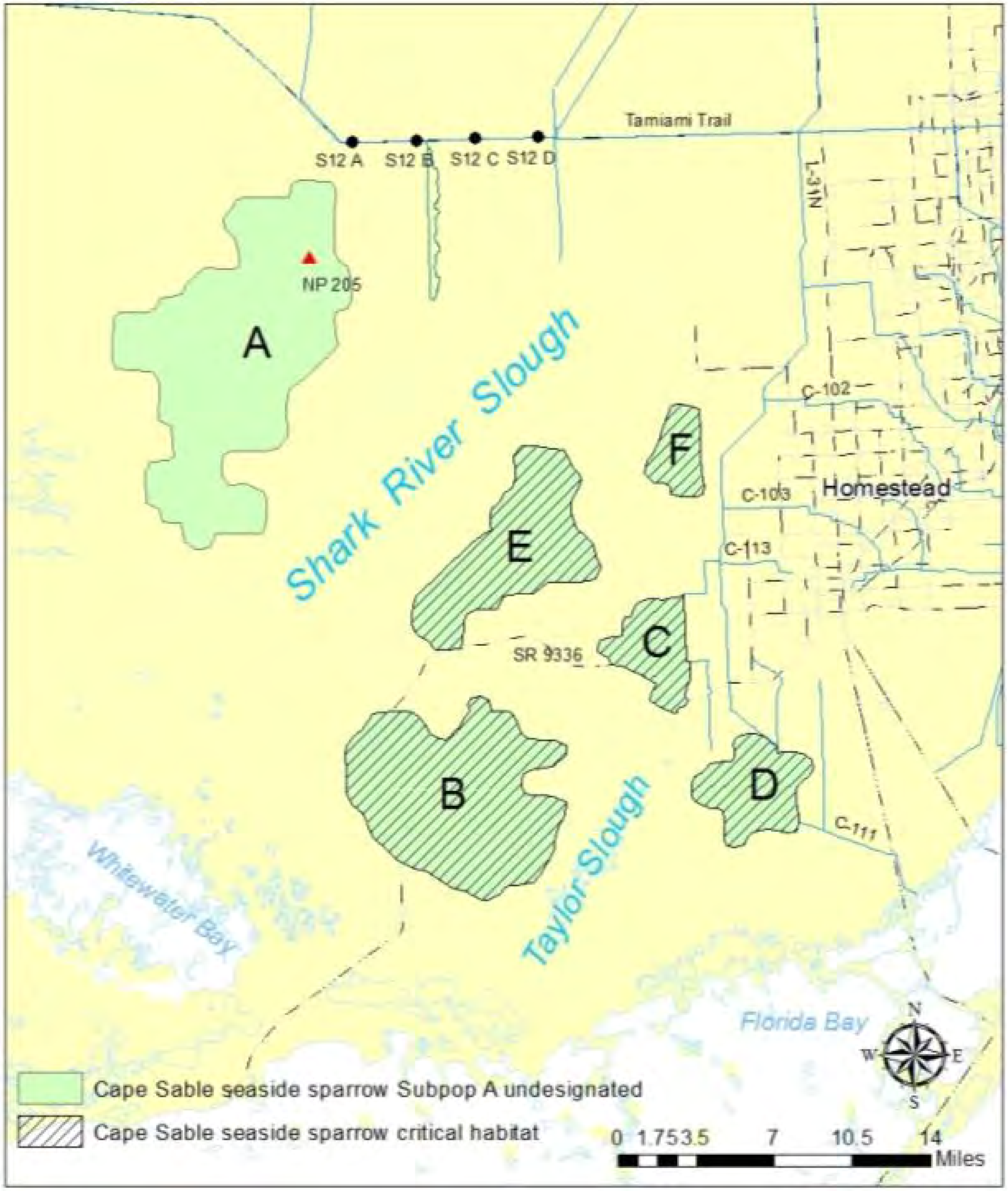


Figure 3: Location of Cape Sable seaside sparrow subpopulations

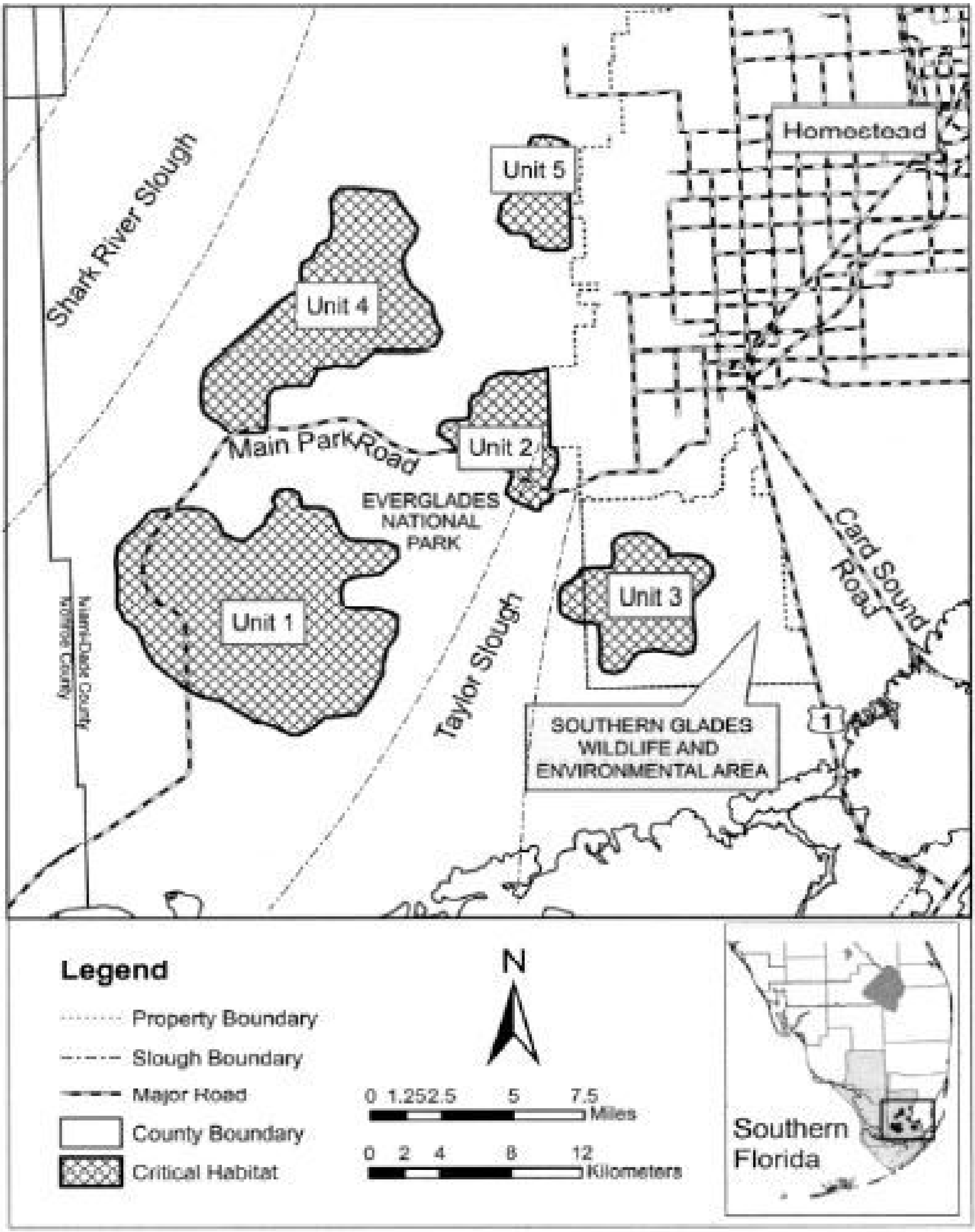


Figure 4: Critical habitat for the Cape Sable seaside sparrow

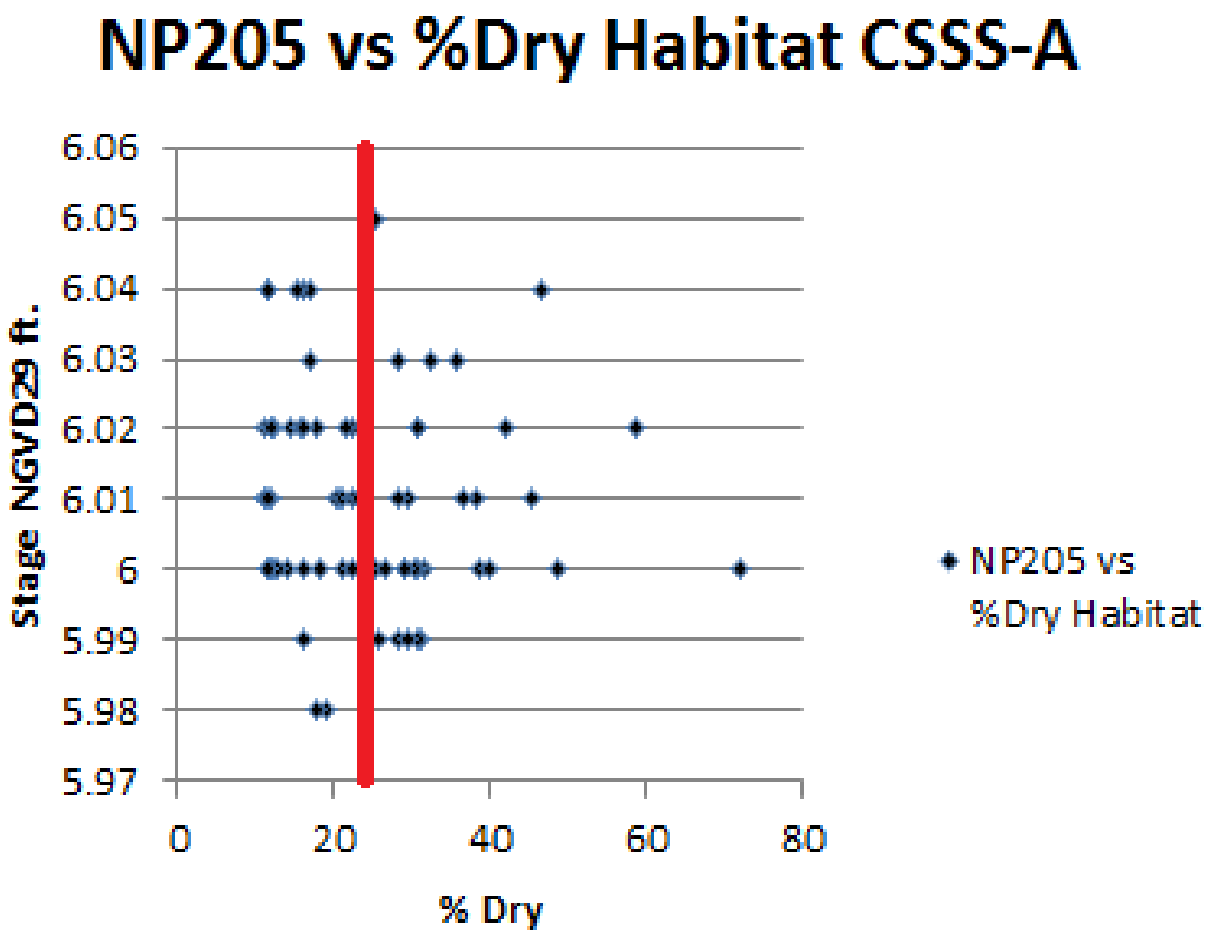


Figure 5: Scatter plot of NP-205 Stage (NGVD29) ft. ± 0.05, versus % dry habitat in CSSS-A based on Sparrow Viewer Tool data, 1990 to 2015. Red line illustrates the average 24.2% habitat position within the plot.

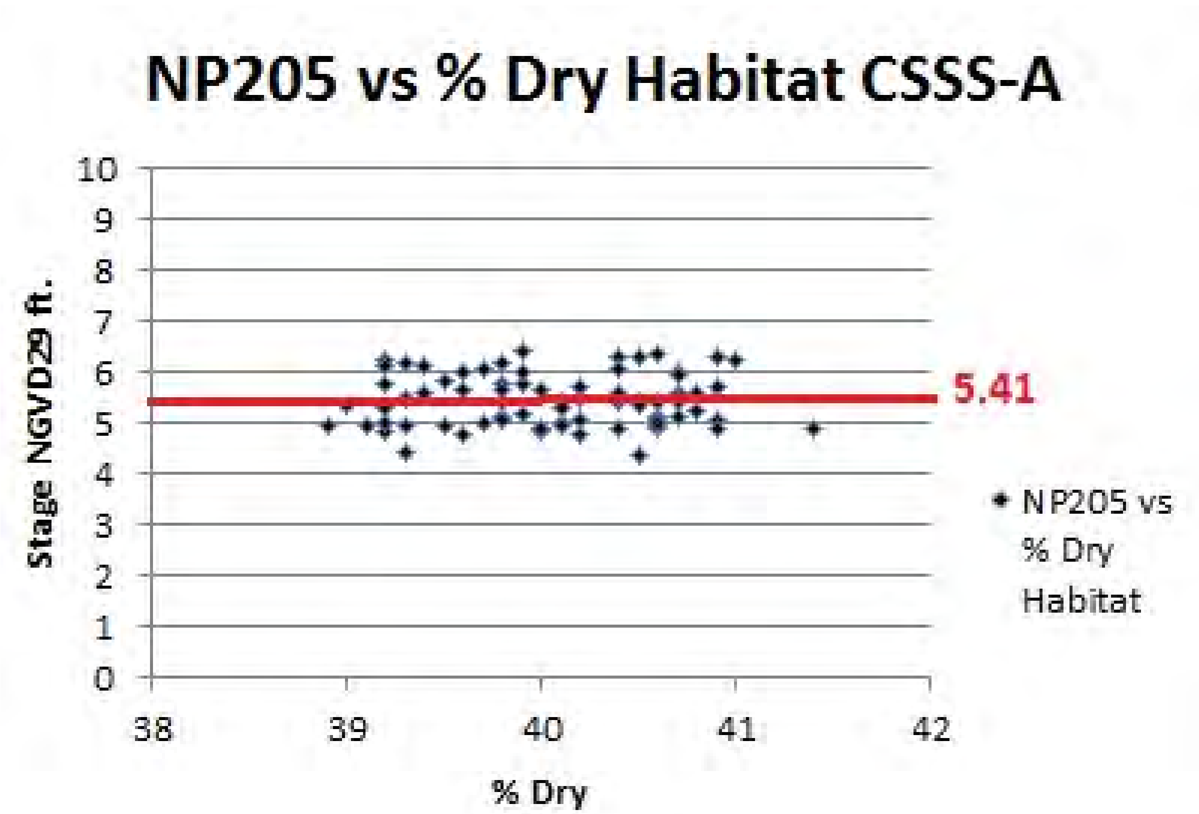


Figure 6: Scatter plot of NP-205 Stage (NGVD29) ft., versus 40% dry habitat ± 2%, in CSSS-A based on Sparrow Viewer Tool data, 1990 to 2015. Red line illustrates the average 5.41 ft. stage position within the plot.

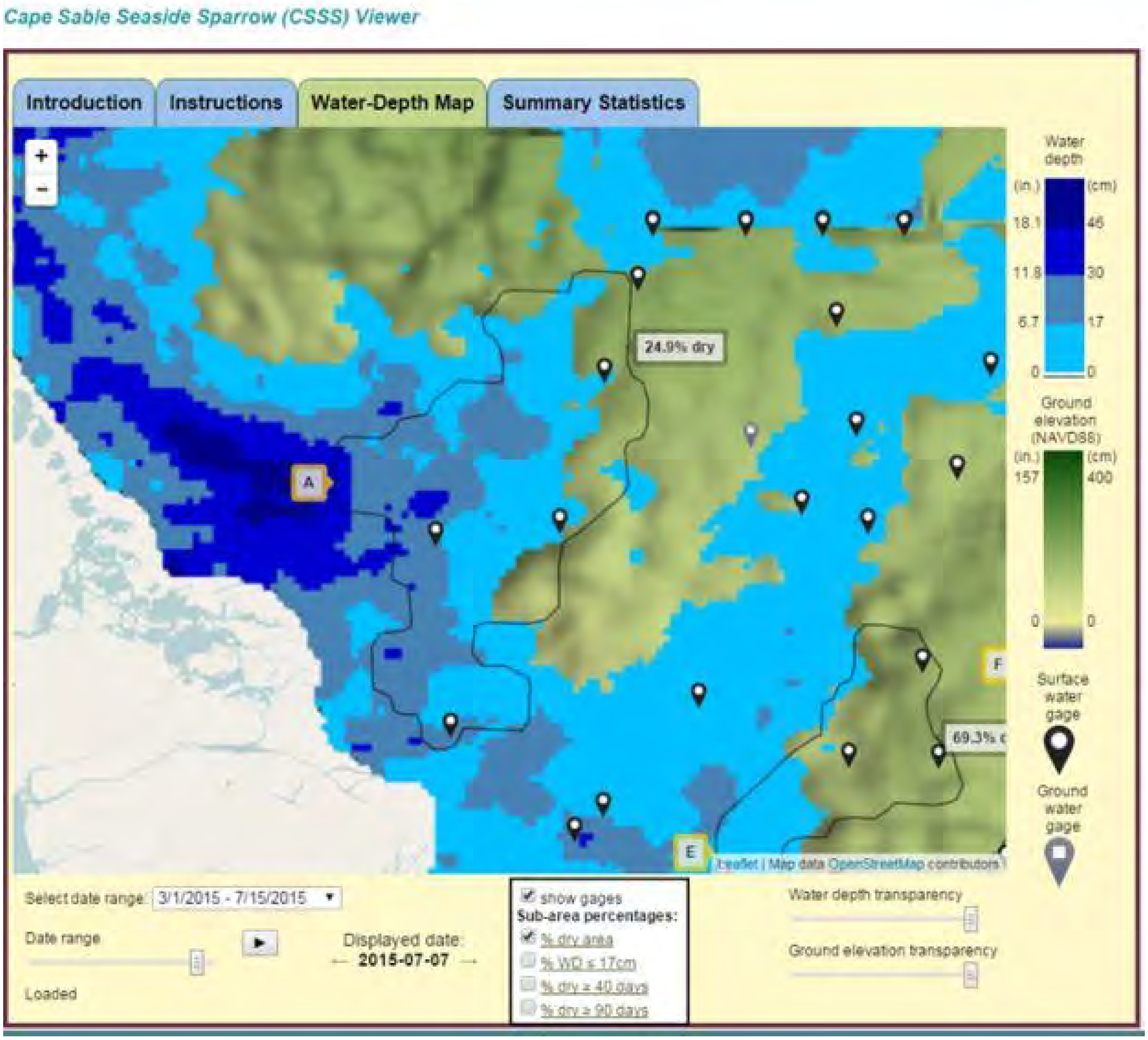


Figure 7: Snapshot of Sparrow Viewer output on July 7, 2015. Current CSSS-A delineated habitat is outlined at center in black. Blue areas show water levels above ground according to the water depth scale at top left, and green areas are dry. On this date 24.9% of CSSS-A delineated habitat is dry. Note the extent of expanded dry area indicated to the East of the outlined delineated habitat.

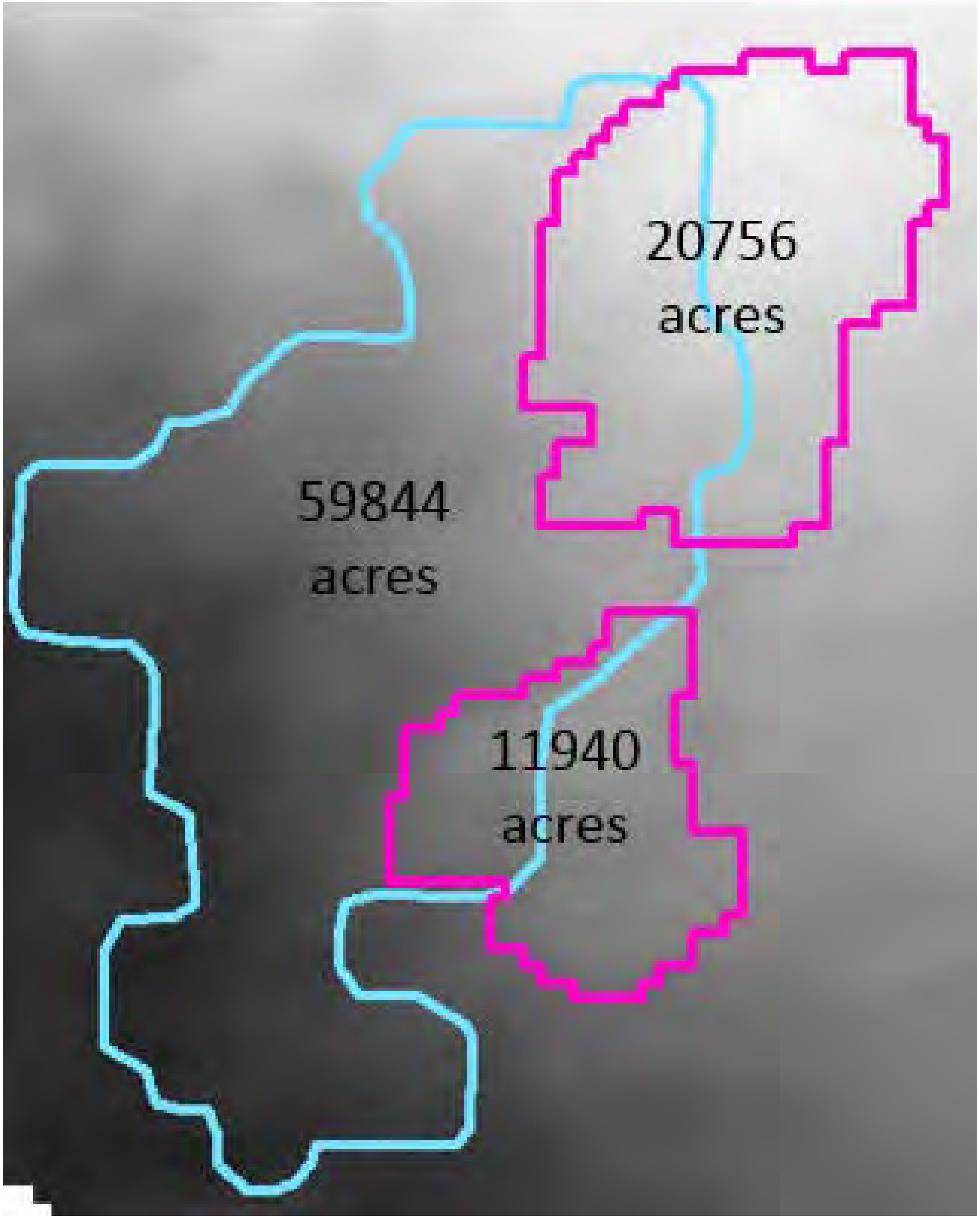


Figure 8: CSSS-A delineated habitat (light blue), and expanded habitat areas (tdN and tdS, purple) to the east and their acreages analyzed as part of the ERTP-2016 RSM modeling.

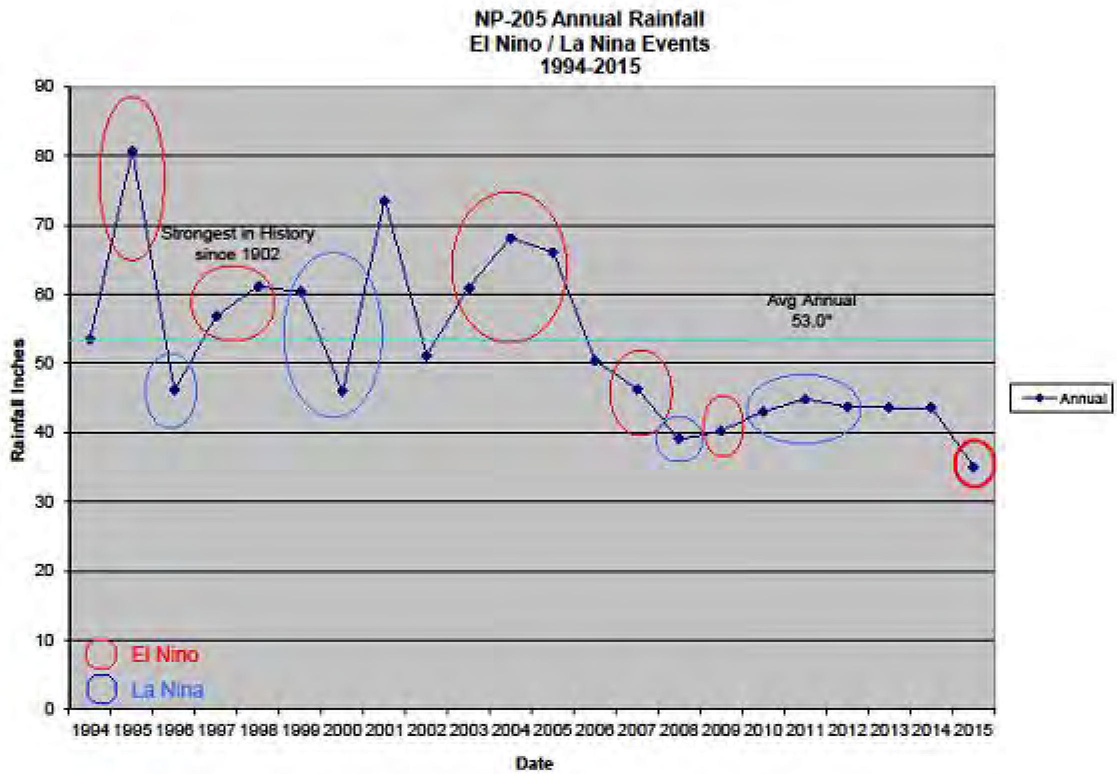


Figure 9: Annual rainfall and frequency of El Nino and La Nina events at gauge NP-205 from 1994 into 2015.

Figure 10: Cape Sable seaside sparrow population estimate, 1981 - 2015, subpopulations A through F and total. The dashed red line illustrates the 2,915 bird total population level ERTP trigger criteria.

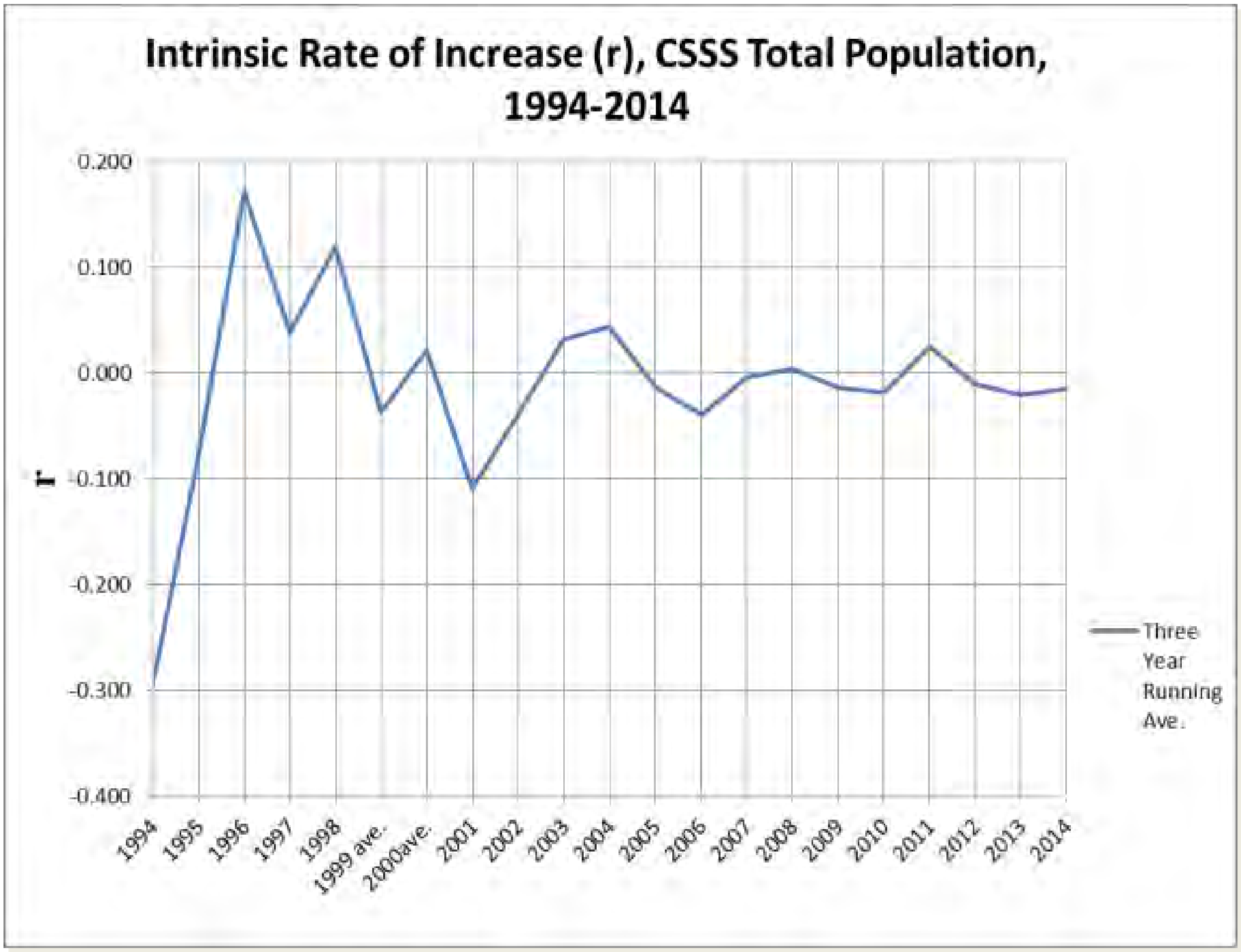


Figure 11: The intrinsic rate of increase of the total Cape Sable seaside sparrow population from 1994 to 2014. An (*r*) greater than 0 indicates an increasing population; *r* less than 0 indicates a declining population. From 1994 to 2004, the three year running average of *r* was greater than 0 in 6 years, and less than 0 in 4 years. Within the last 10 years, the three year running average of *r* was greater than 0 in 2 years, and less than 0 in 8 years.

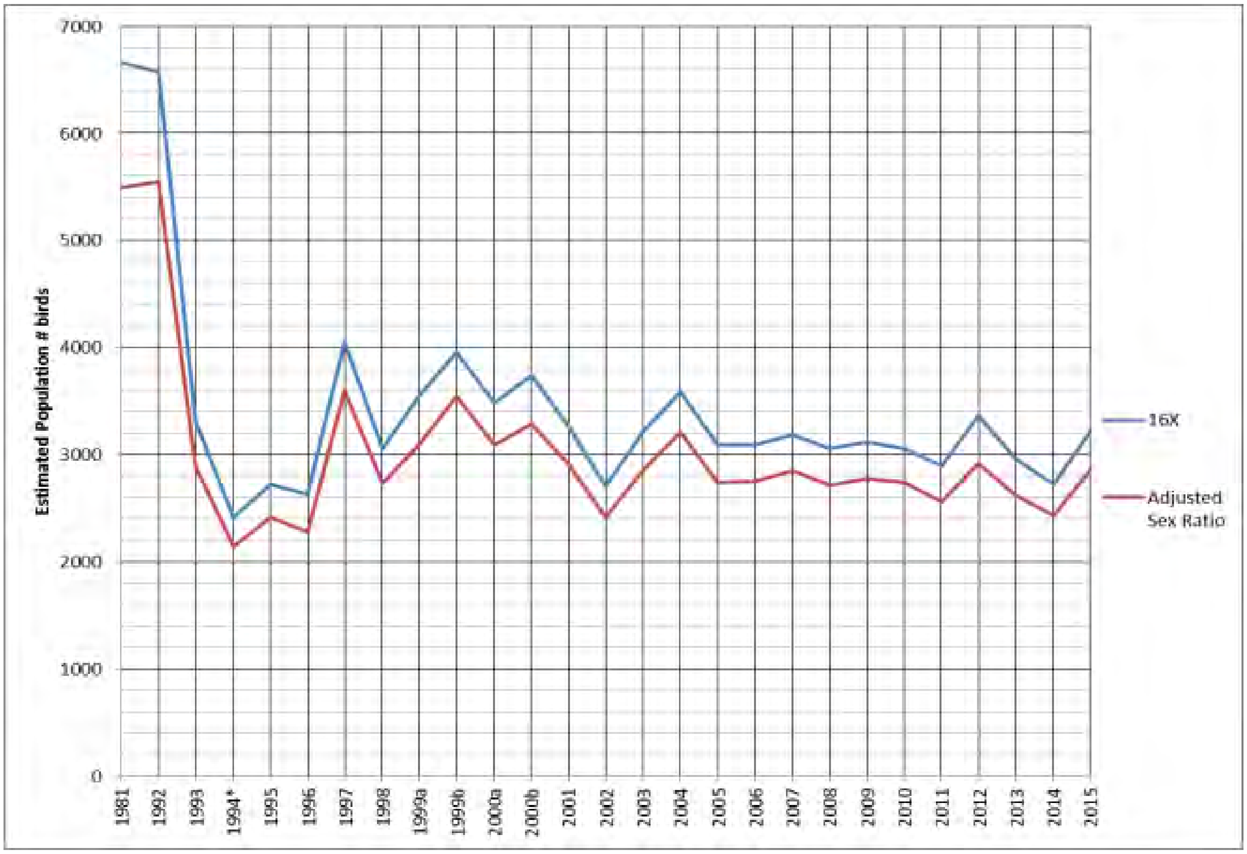


Figure 12: Original CSSS total population estimate (16X), compared to total population estimate with adjusted sex ratio, 1981-2015.

Figure 13: Documented locations of invasive constrictor snakes and tegus in the vicinity of CSSS-D and CSSS-C. Data source http://www.eddmaps.org/florida/distribution/.

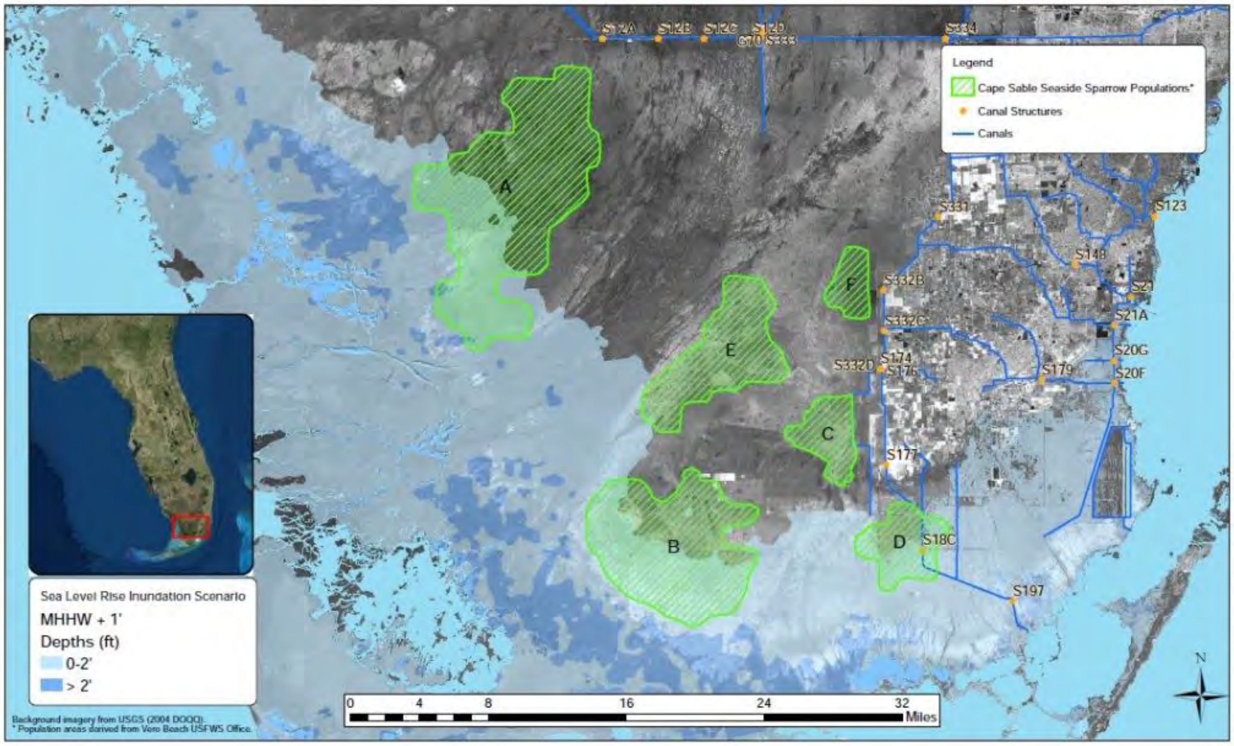


Figure 14: Sea level rise (MHHW +1ft.). Cape Sable seaside sparrow subpopulations are shown in green.

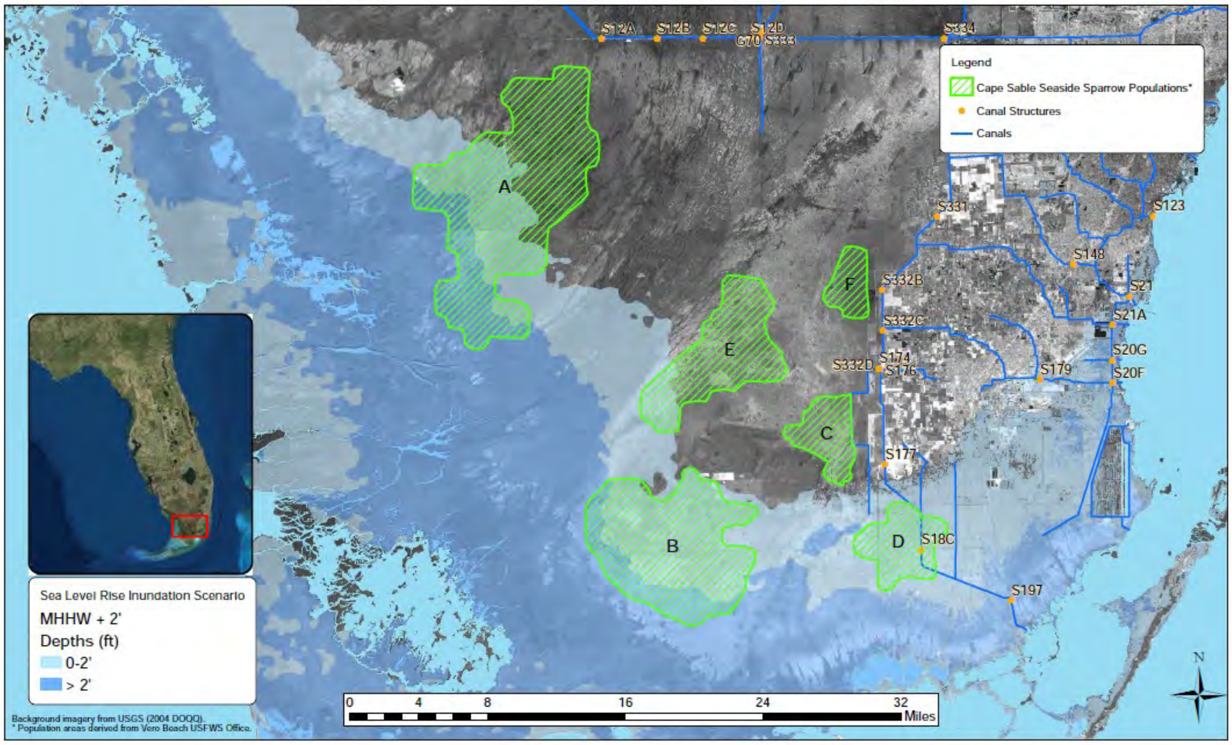


Figure 15: Sea level rise (MHHW +2ft.). Cape Sable seaside sparrow subpopulations are shown in green.

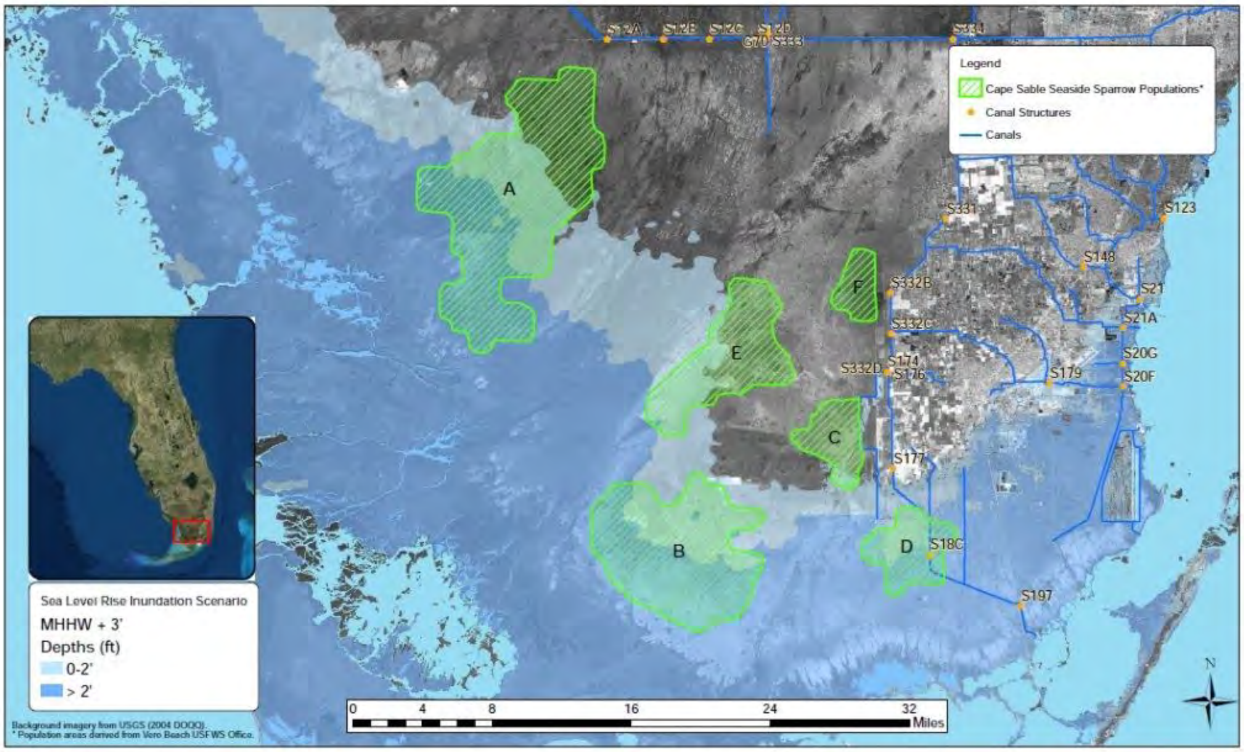


Figure 16: Sea level rise (MHHW +3ft.). Cape Sable seaside sparrow subpopulations are shown in green.

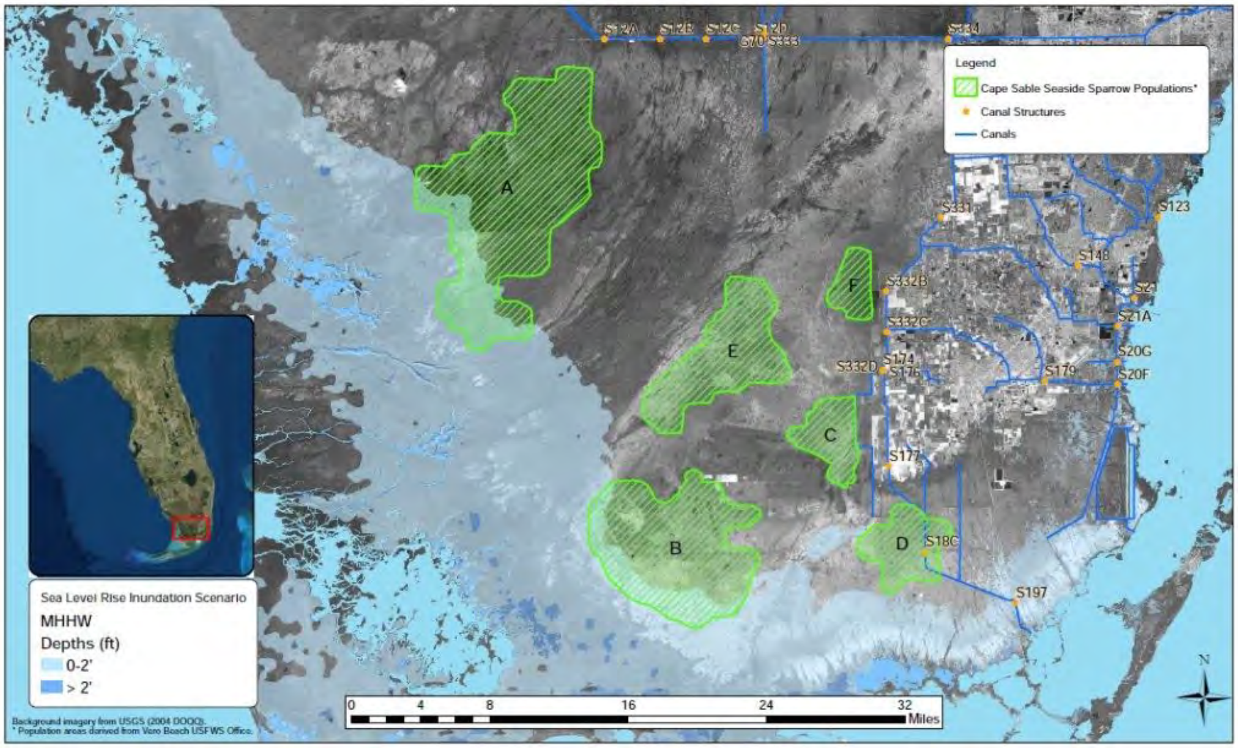


Figure 17: Sea level rise (MHHW 0ft.). Current baseline condition. Cape Sable seaside sparrow subpopulations are shown in green.

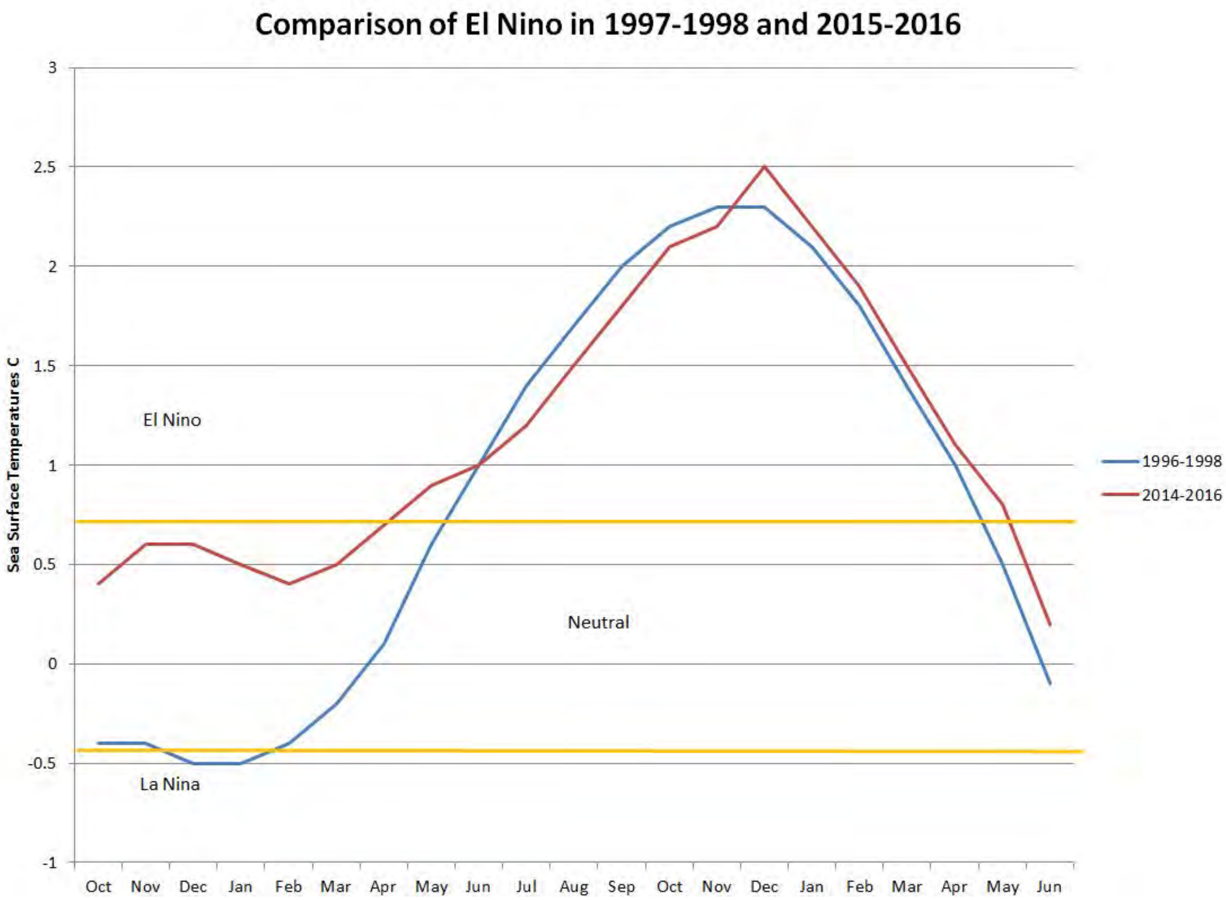
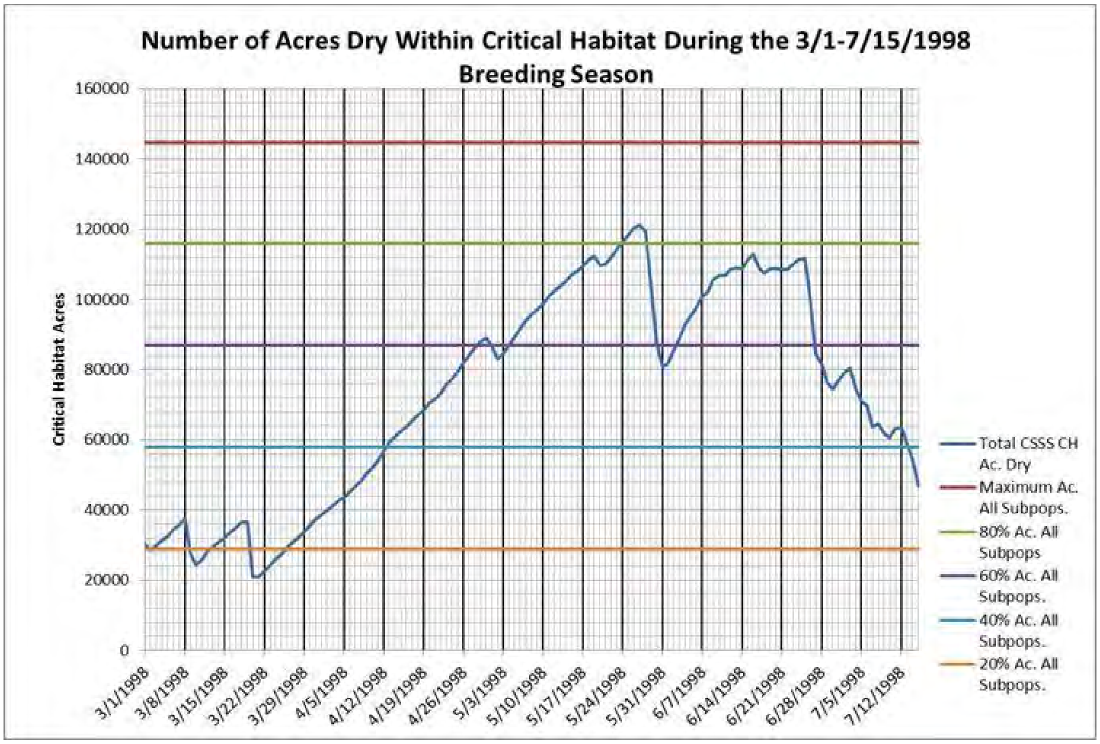


Figure 18: Sea surface temperatures (°C) in the Nino 3.4 portion of the Pacific Ocean during the very strong El Nino conditions of 2015-2016 as compared to the previous very strong El Nino in 1997-1998.



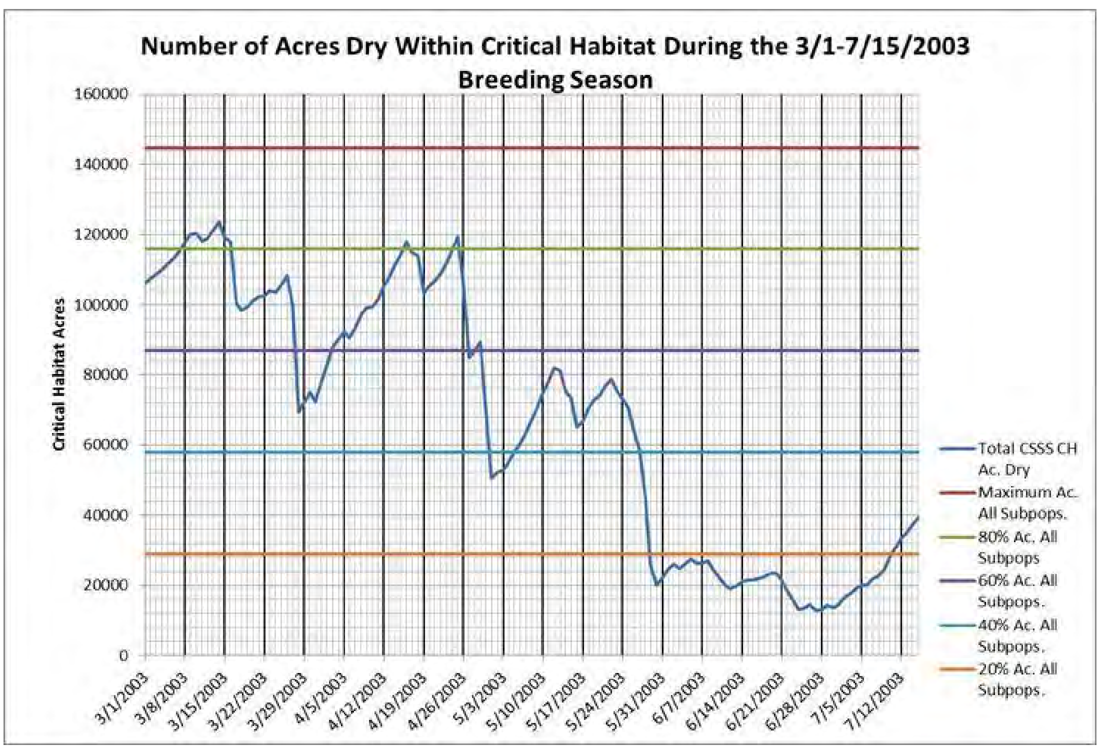


Figure 19: 1998 and 2003 historical El Nino years. The 60% threshold of dry habitat occurred for only 55 and 50 days respectively.

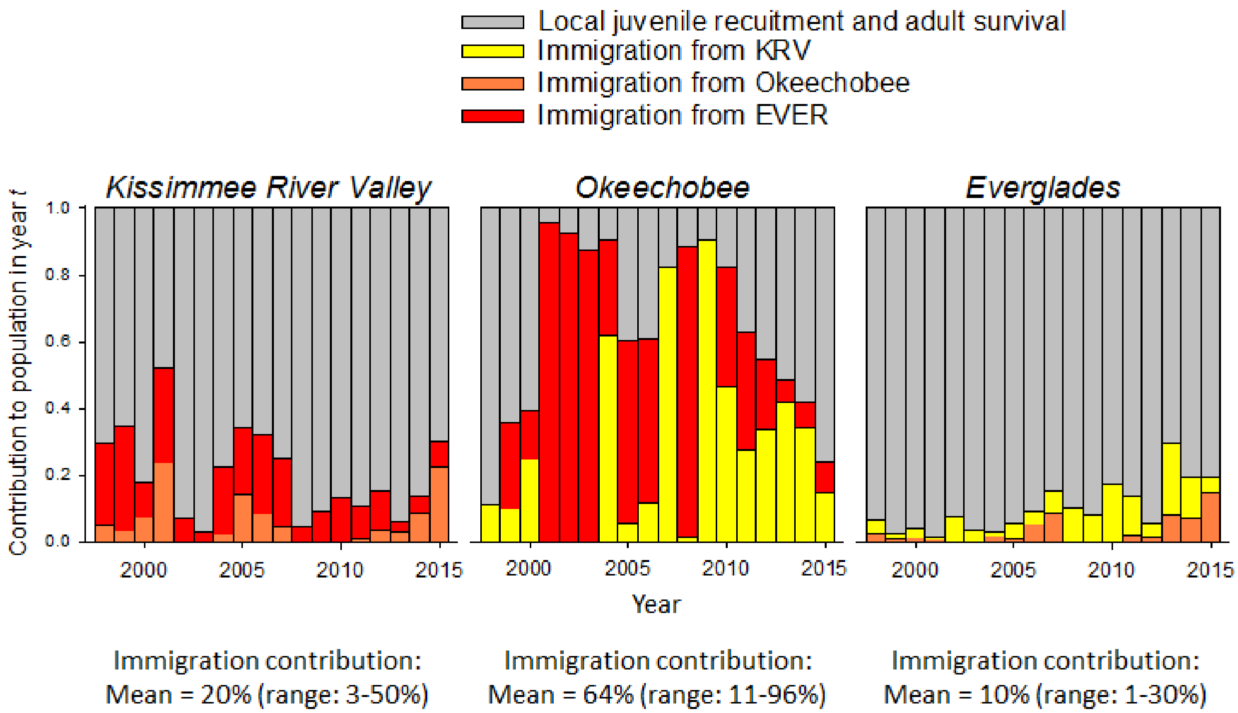


Figure 20: Estimated contributions to the observed population growth of the subpopulations in the Kissimmee River Valley (northern region), Okeechobee, and the Everglades (southern region). Figure provided by Fletcher (2015b pers comm).

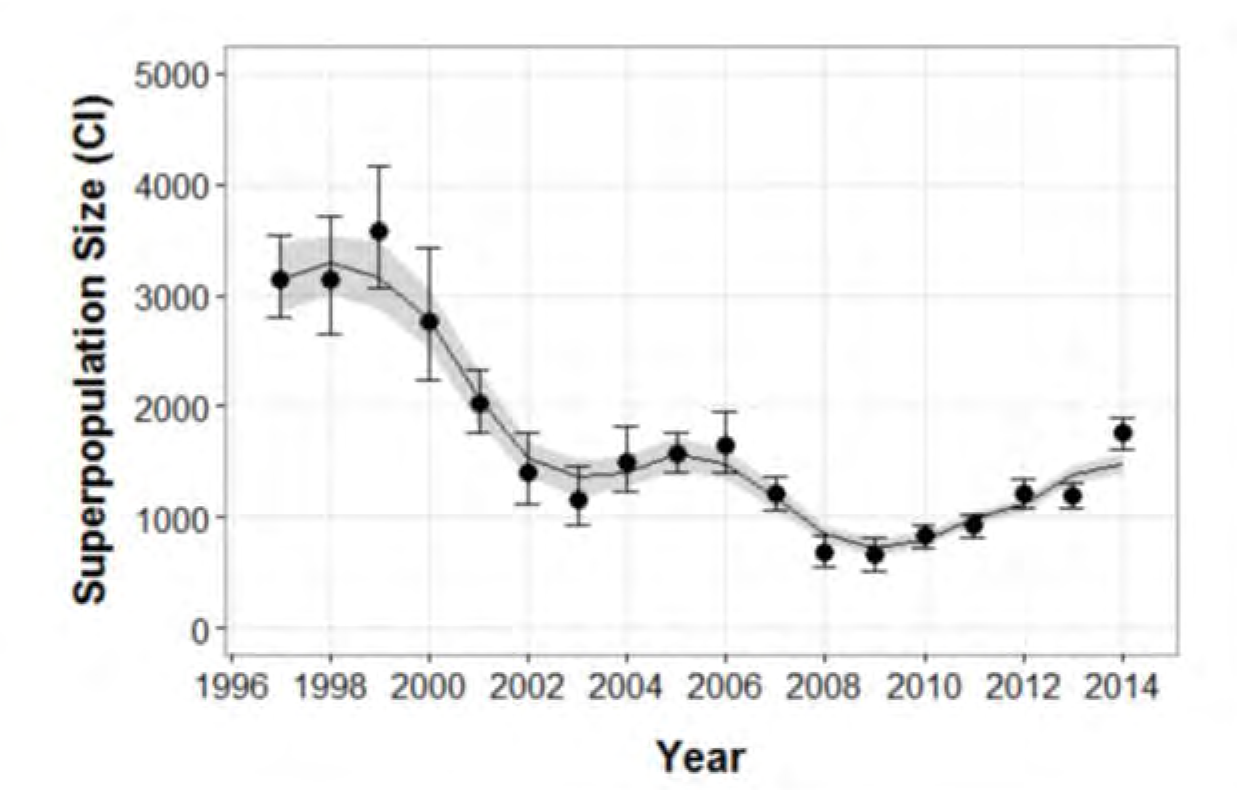


Figure 21: Estimated snail kite population size from 1997 to 2014 using the super-population approach (Dreitz et al. 2002; Martin et al. 2007). Black dots (and error bars) show population size estimates for each year (and 95% CI); note that each year is estimated independently (*i.e.,* only information from that year is used in calculations). The black line shows the 3-year running average and gray shaded region shows the uncertainty around the 3-year running average (95% CI, taken from non-parametric bootstrapping). Figure taken from Fletcher et al. 2015.

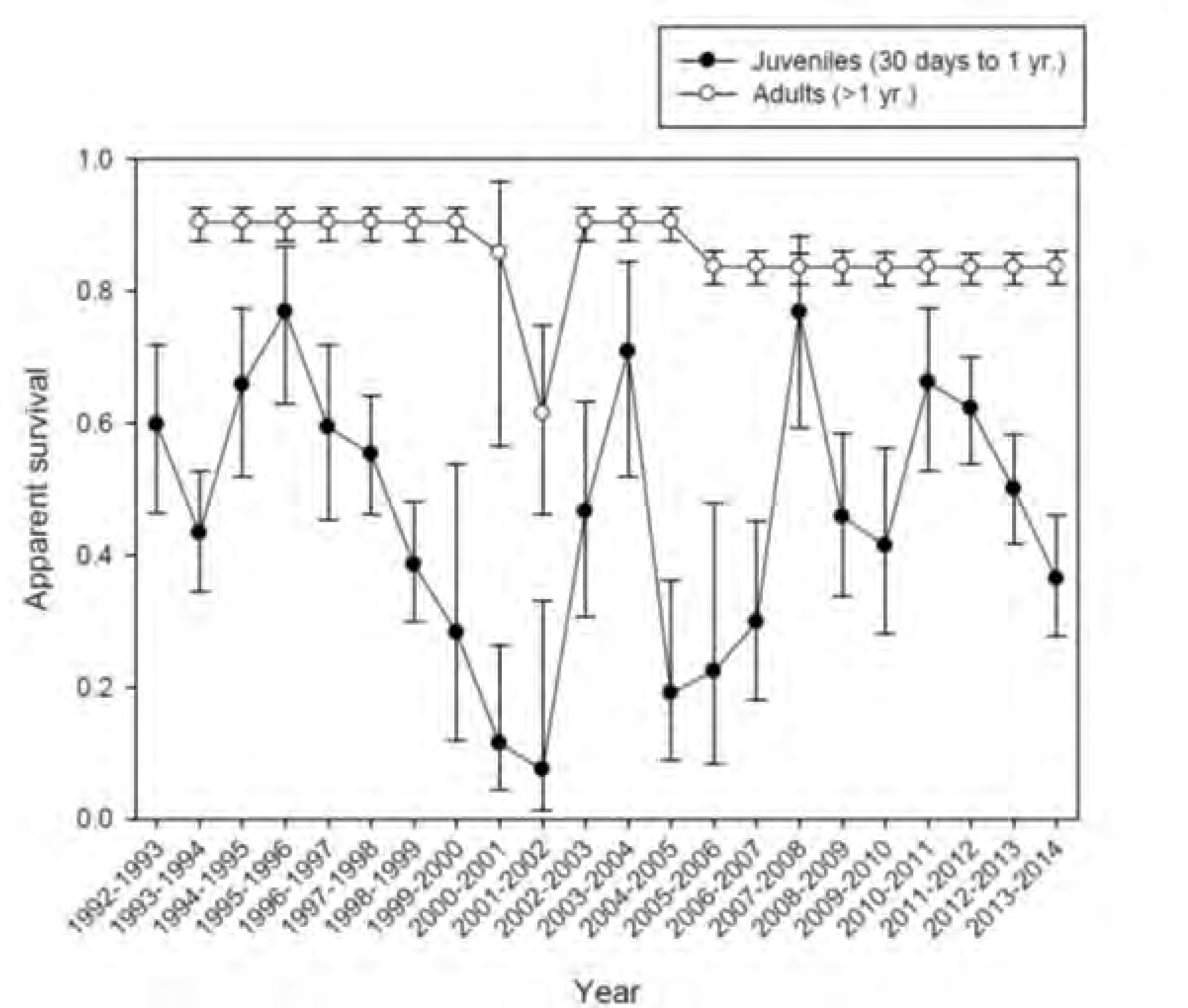


Figure 22: Model-averaged estimates of adult (white circles) and juvenile (black circles) apparent annual survival from 1992 to 2014. Error bars correspond to 95 percent confidence intervals (CI). Figure taken from Fletcher et al. 2015.

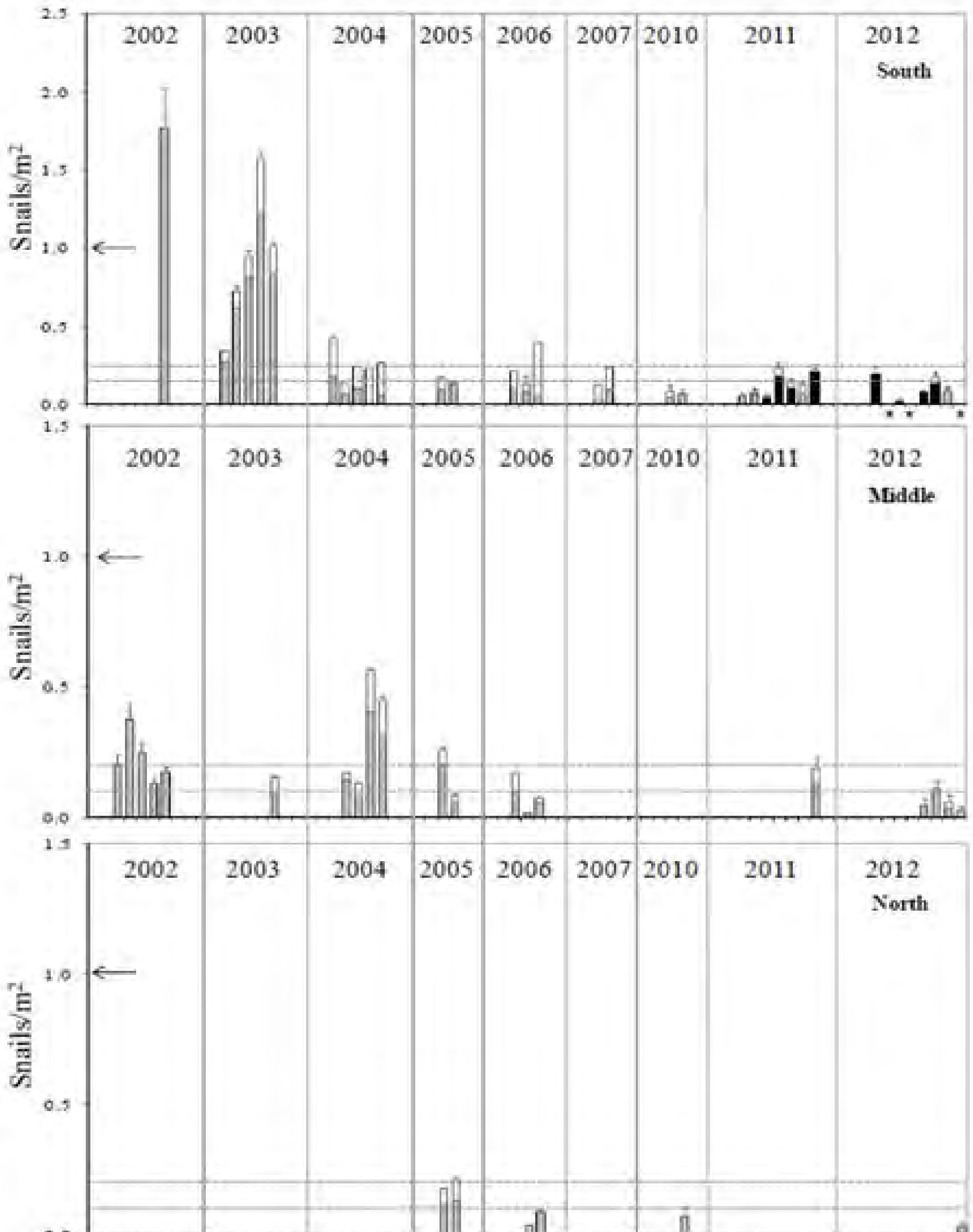


Figure 23: Adjusted snail densities (snails per m^2), including exotic snails, in WCA-3A sites sampled in 2002-2012. Grey portion represents the adult snail density (>20mm shell width). White portion represents the juvenile snail density. Black bars indicate sites that had exotic snails. All densities are adjusted for capture probability. Error bars are S.E. Within each panel sites are listed from left to right for southern to northern locations. Dotted lines refer to snail densities of 0.2 and 0.1 snails/m^2 for reference. Figure taken from Wight et al. 2013.

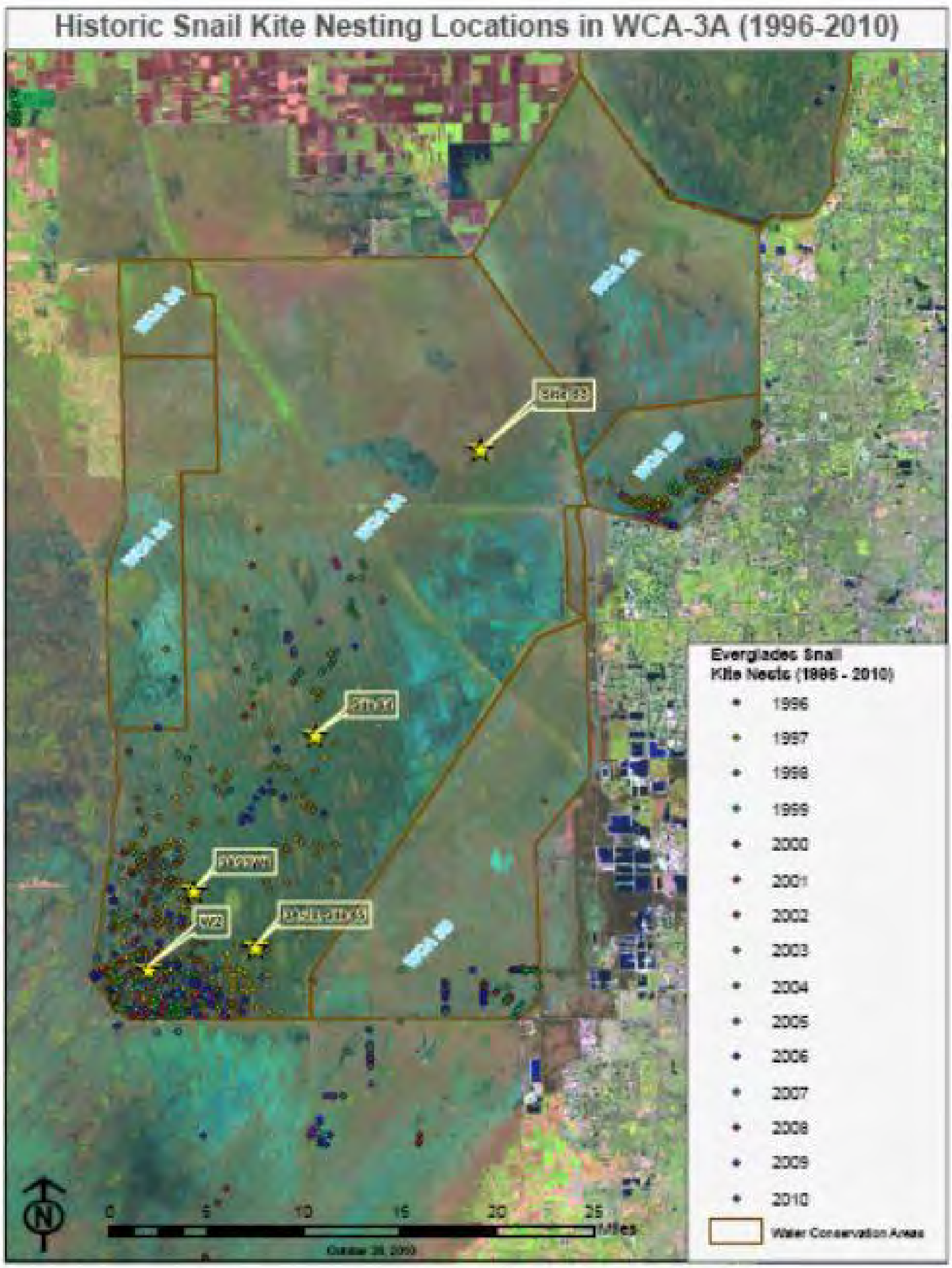


Figure 24: Map showing historic kite nesting locations and the location of surface water gauges in central and southern WCA-3A.

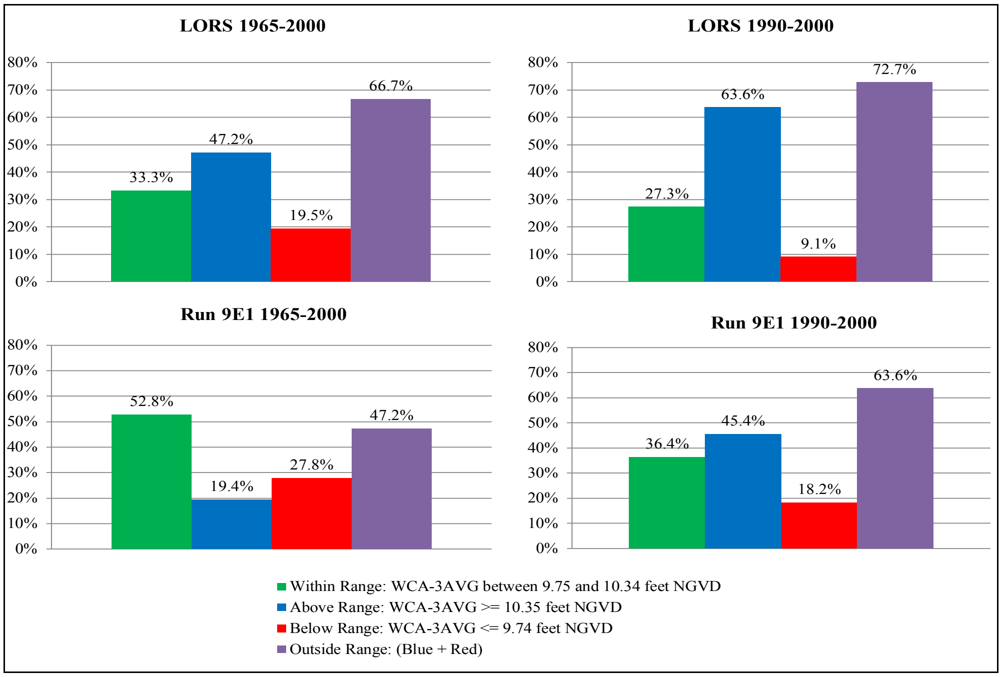


Figure 25: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of years during which the stage on December 31 (3AVG) is within the recommended range for snail kites.

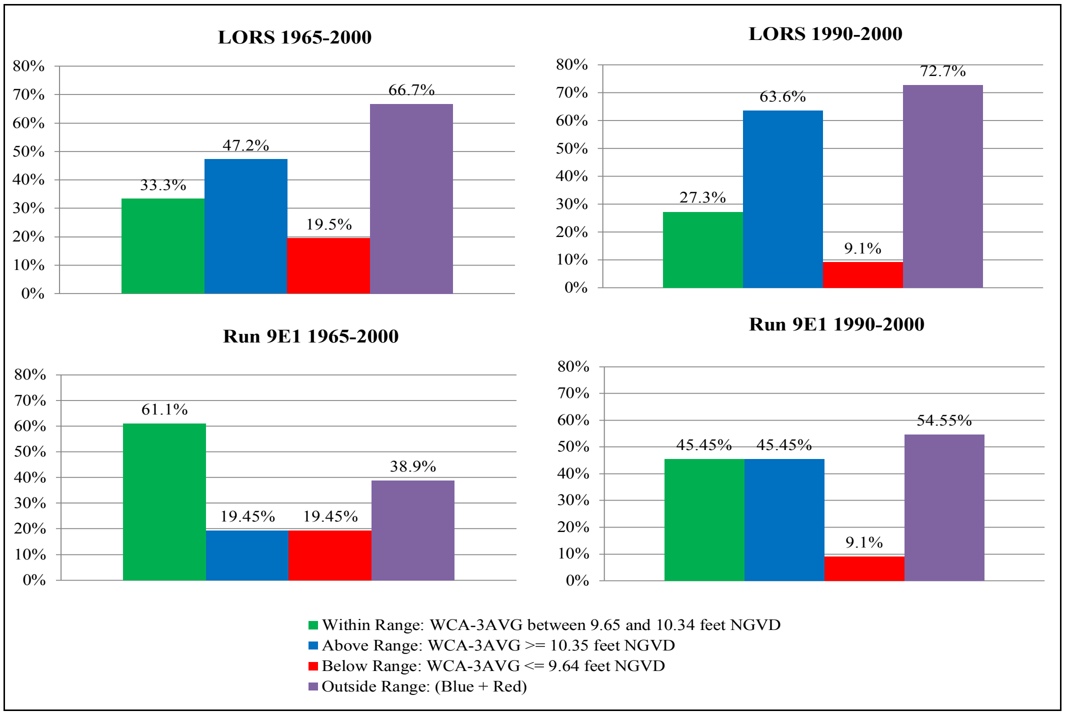


Figure 26: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of years during which the stage on December 31, as measured by the 3AVG, is within the recommended range for apple snails.

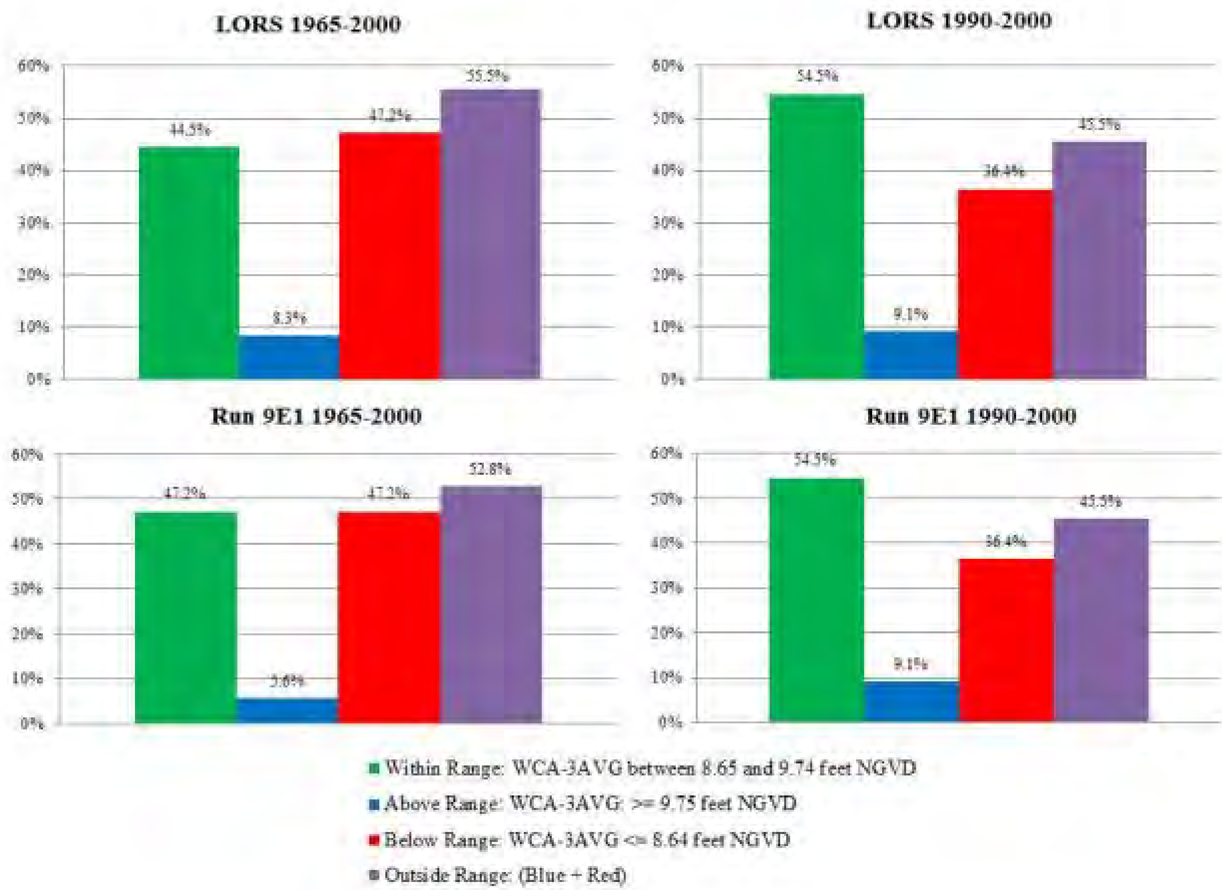


Figure 27: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of years during which the stage between May 1 and June 1, as measured by the 3AVG, is within the recommended range for apple snails.

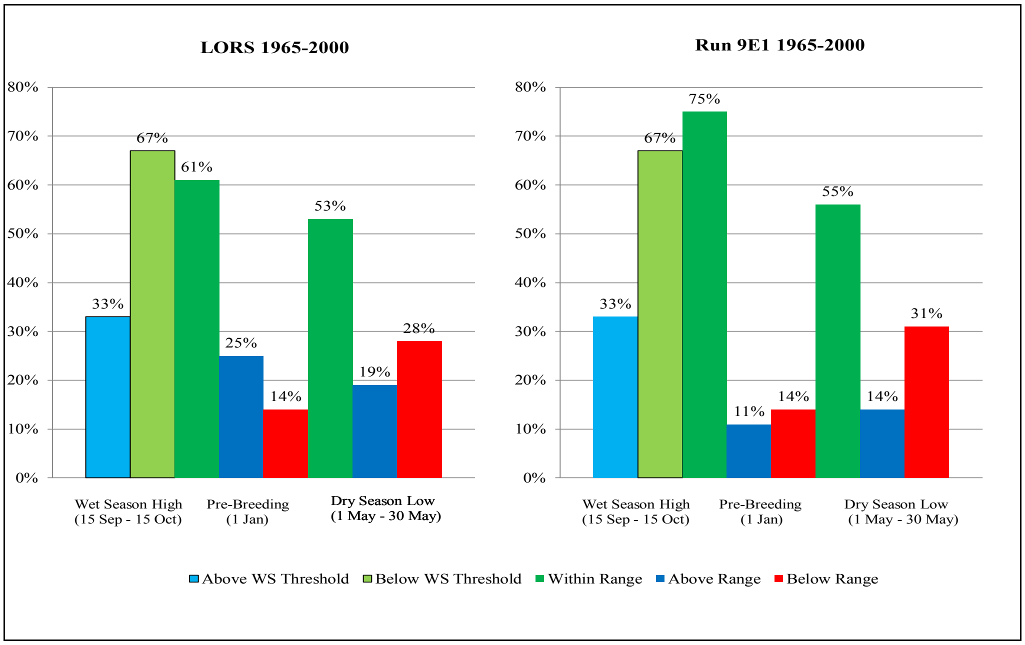


Figure 28: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of years in which WCA-3A water levels, as measured by the 3AVG, are above or below the wet season threshold and within, above, or below the pre-breeding and dry season ranges recommended in MSTS.

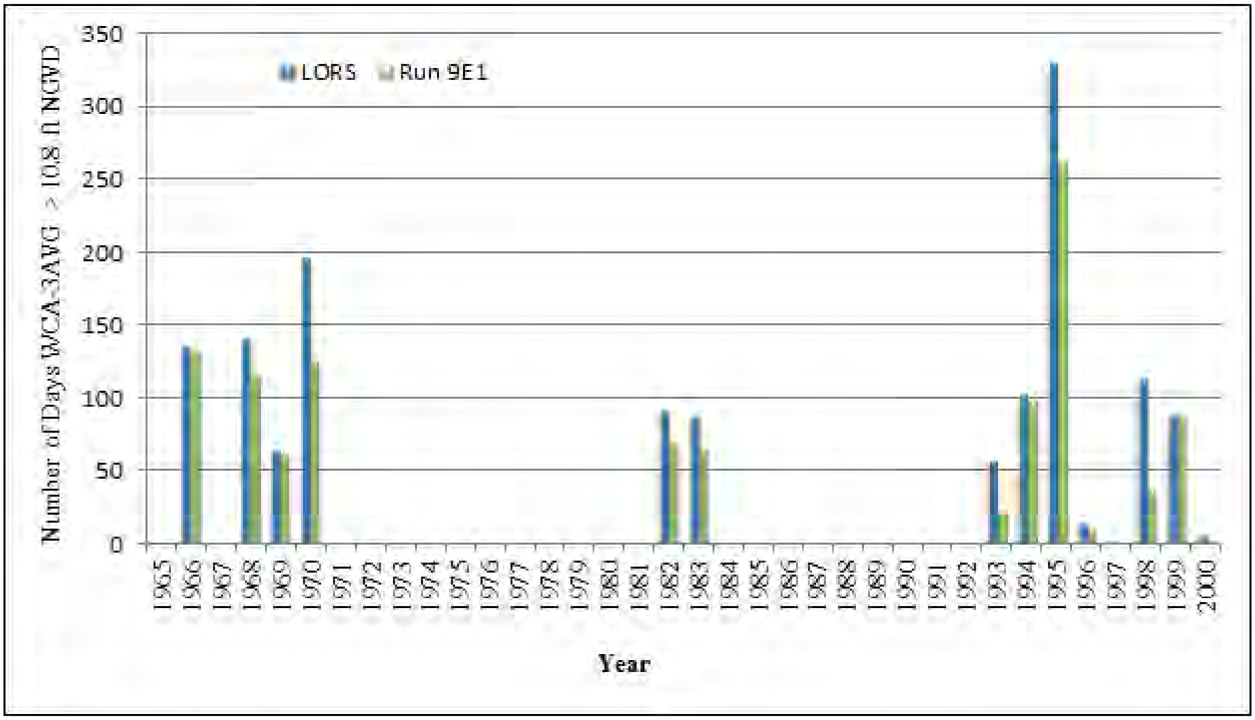


Figure 29: Number of days per year WCA-3A water levels (3AVG) exceeded 10.8 ft NGVD from 1965 to 2000 under LORS (IOP) and 9E1 (ERTP) model runs.

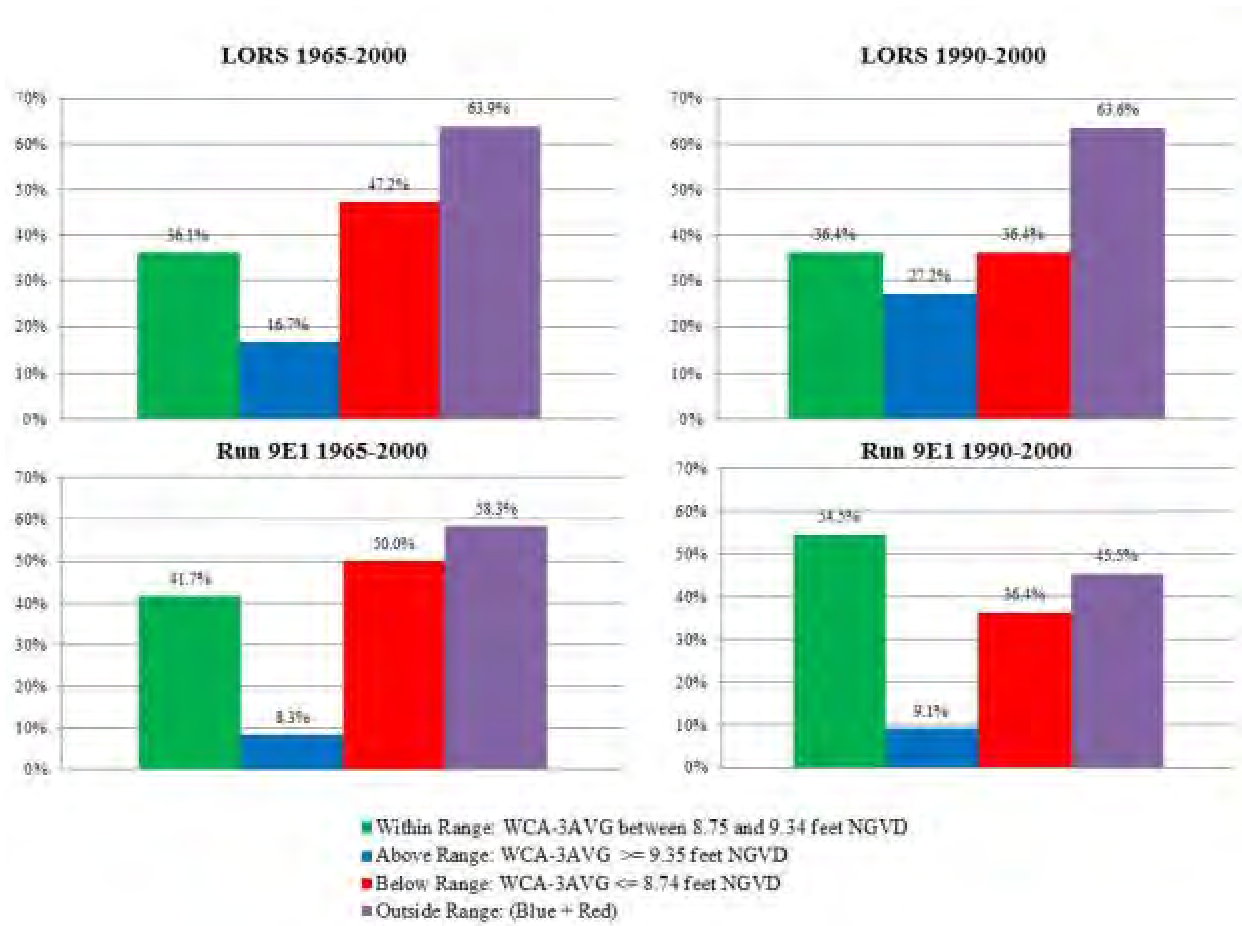


Figure 30: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of years during which the stage between May 1 and June 1, as measured by 3AVG, is within the recommended range for snail kites.

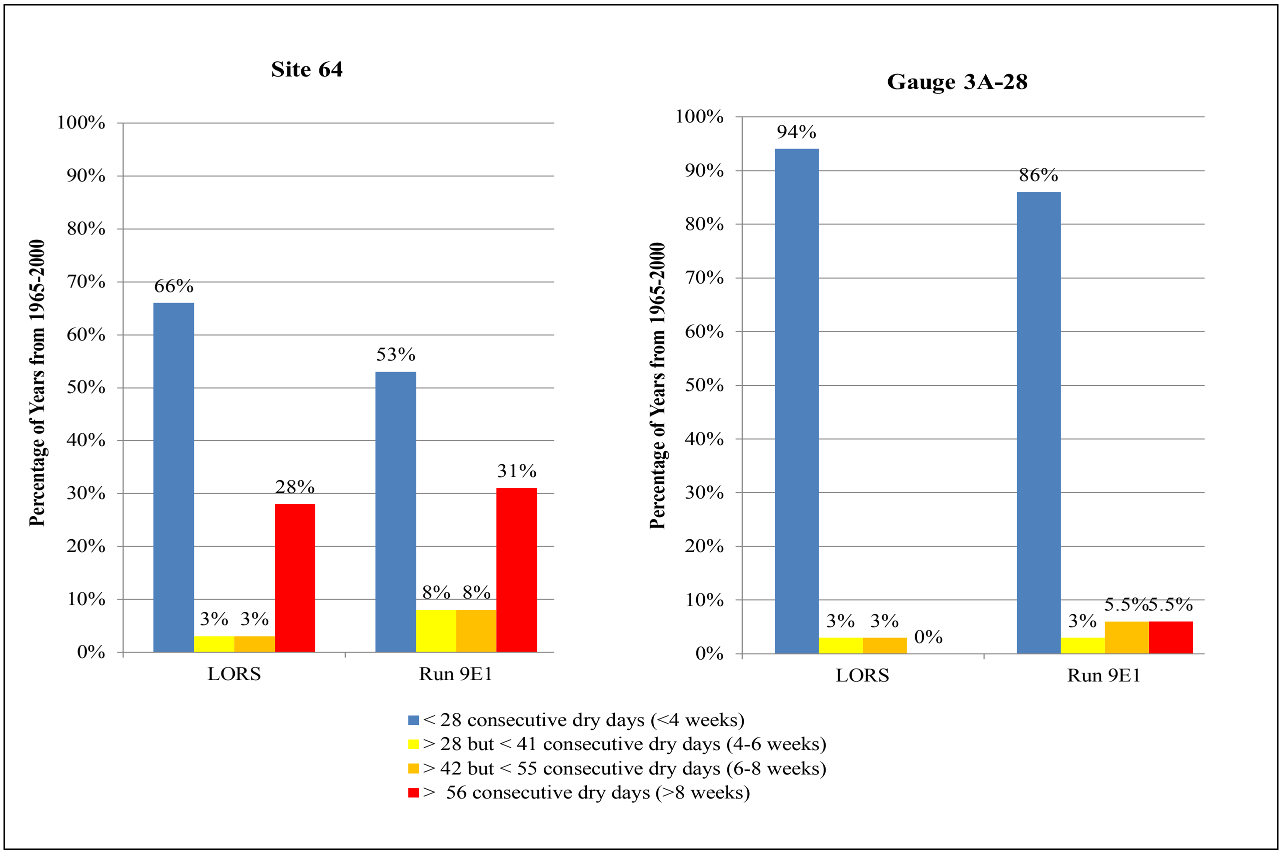


Figure 31: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the number of consecutive dry days at gauges Site 64 and 3A-28 (also known as Site 65) from 1965 to 2000.

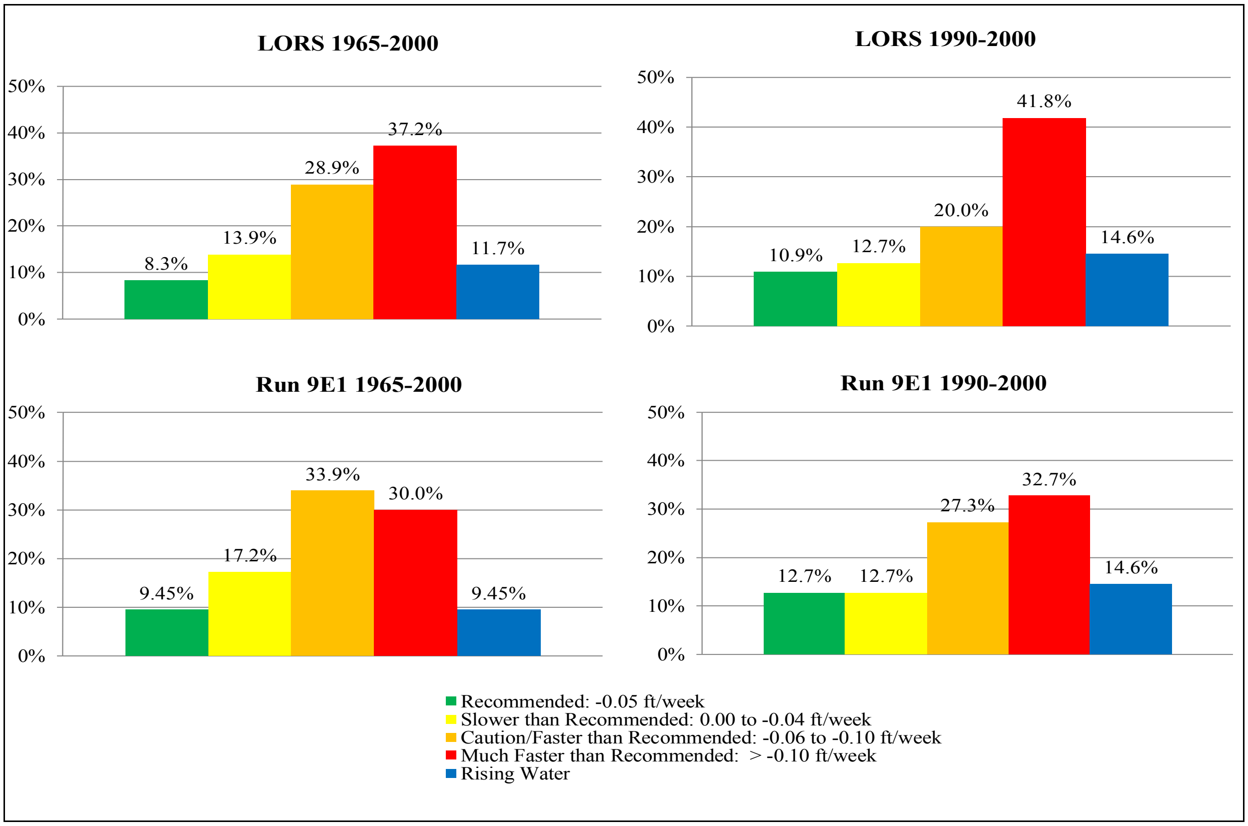


Figure 32: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of months during which the average weekly recession rate between January 1 and June 1, as measured by the 3AVG, is within the recommended range for snail kites. Recession rate was determined by first calculating a weekly average, and then averaging the weekly rate for an entire month.

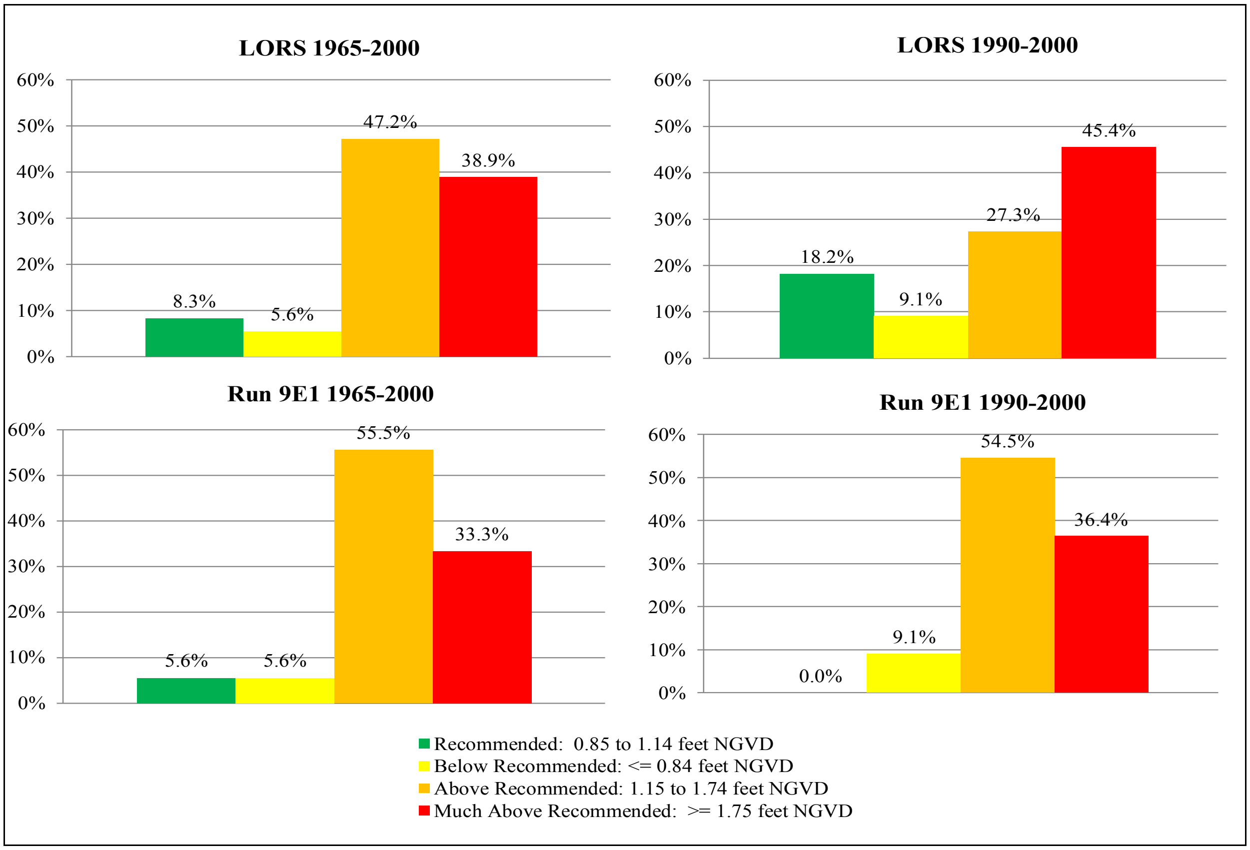


Figure 33: Performance of LORS (IOP) and 9E1 (ERTP) model runs as assessed by the percentage of years when the difference in stage between January 1 and the dry season minimum water level, as measured by the 3AVG, is within the recommended range for snail kites.

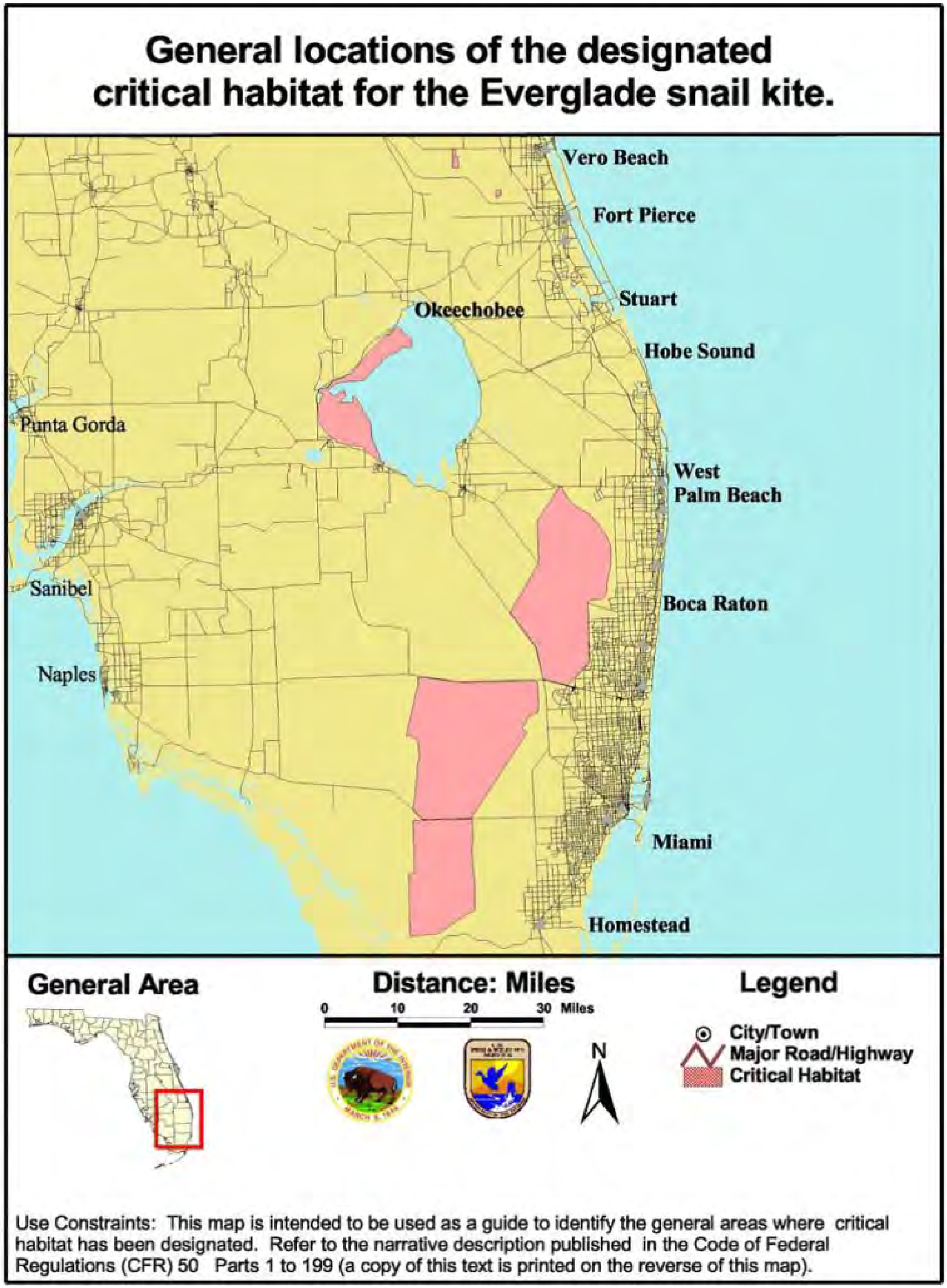


Figure 34: Snail kite designated critical habitat.

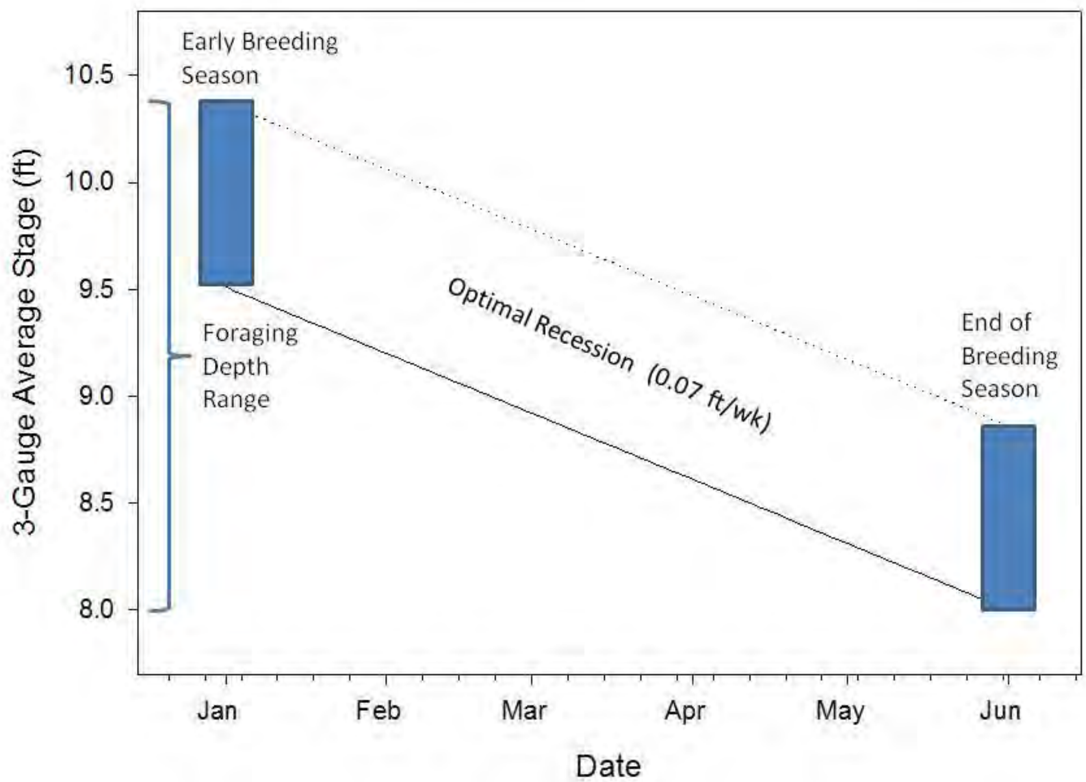


Figure 35: Beerens and Cook (2010) maximum 3AVG stage associated with wood storks feeding in WCA-3A.

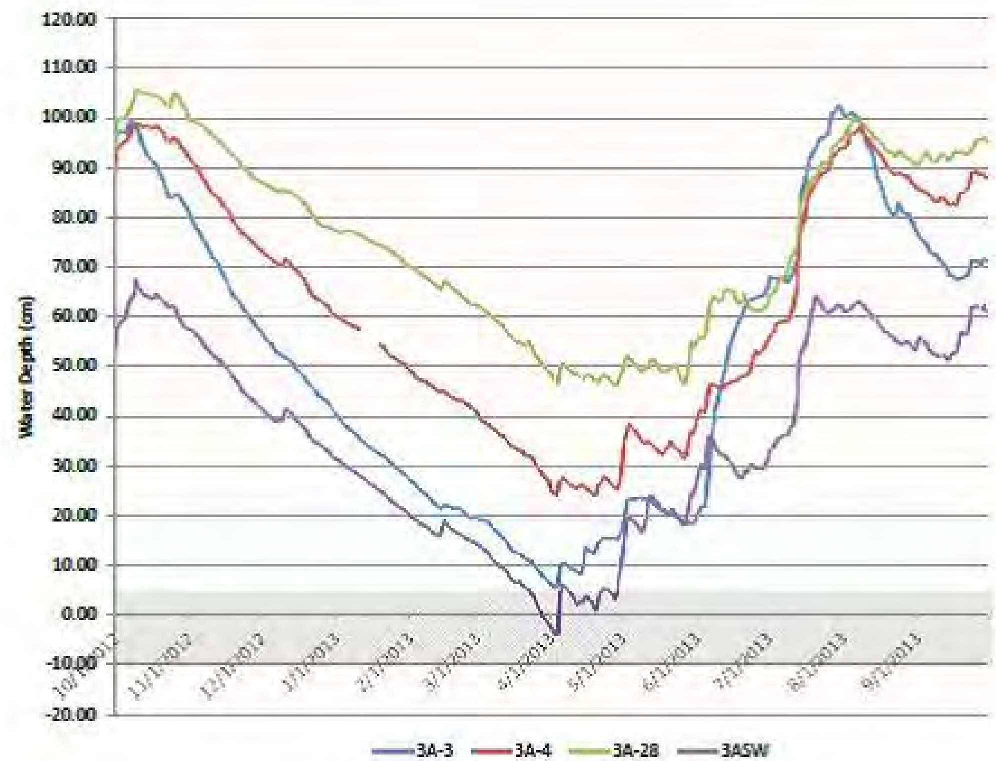


Figure 36: 2013 Wood stork foraging depths within WCA-3A as measured at Gauge 3A-3, Gauge 3A-4, Gauge 3A-28 and Gauge 3ASW.

Figure 37: 2013 Wood stork foraging depths with WCA-3B as measured at Gauge 3B-2 and Gauge 3BS1W1.

Figure 38: 2014 Wood stork foraging depths within WCA-3A as measured at Gauge 3A-3, Gauge 3A-4, Gauge 3A-28 and Gauge 3ASW.

Figure 39: 2014 Wood stork foraging depths with WCA-3B as measured at Gauge 3B-2 and Gauge 3BS1W1.

Figure 40: 2015 Wood stork foraging depths within WCA-3A as measured at Gauge 3A-3, Gauge 3A-4, Gauge 3A-28 and Gauge 3ASW.

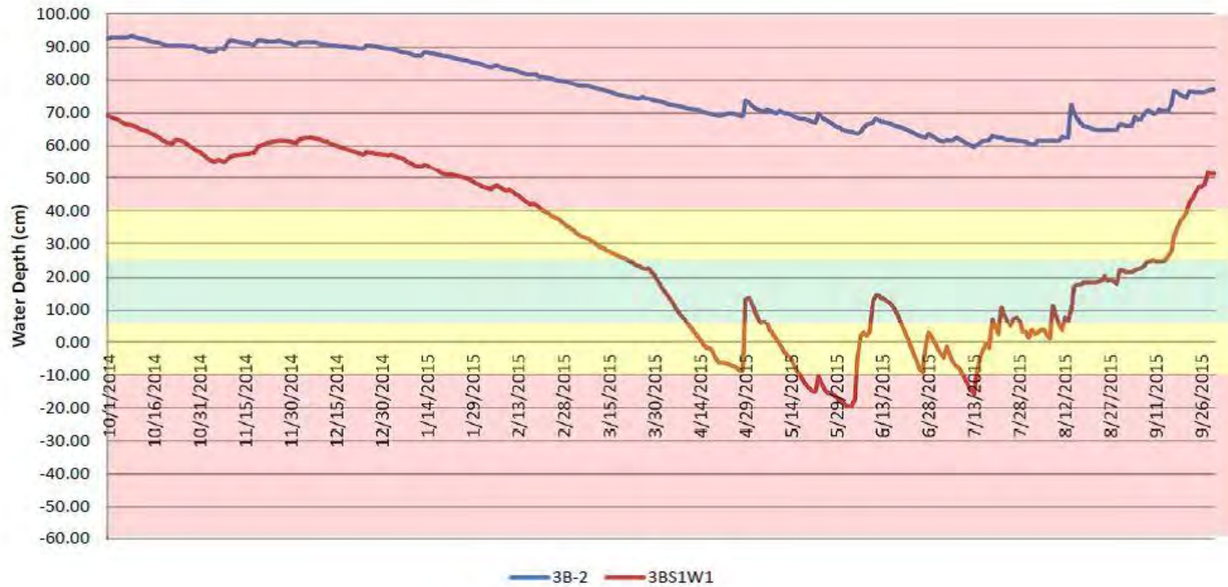


Figure 41: 2015 Wood stork foraging depths with WCA-3B as measured at Gauge 3B-2 and Gauge 3BS1W1.

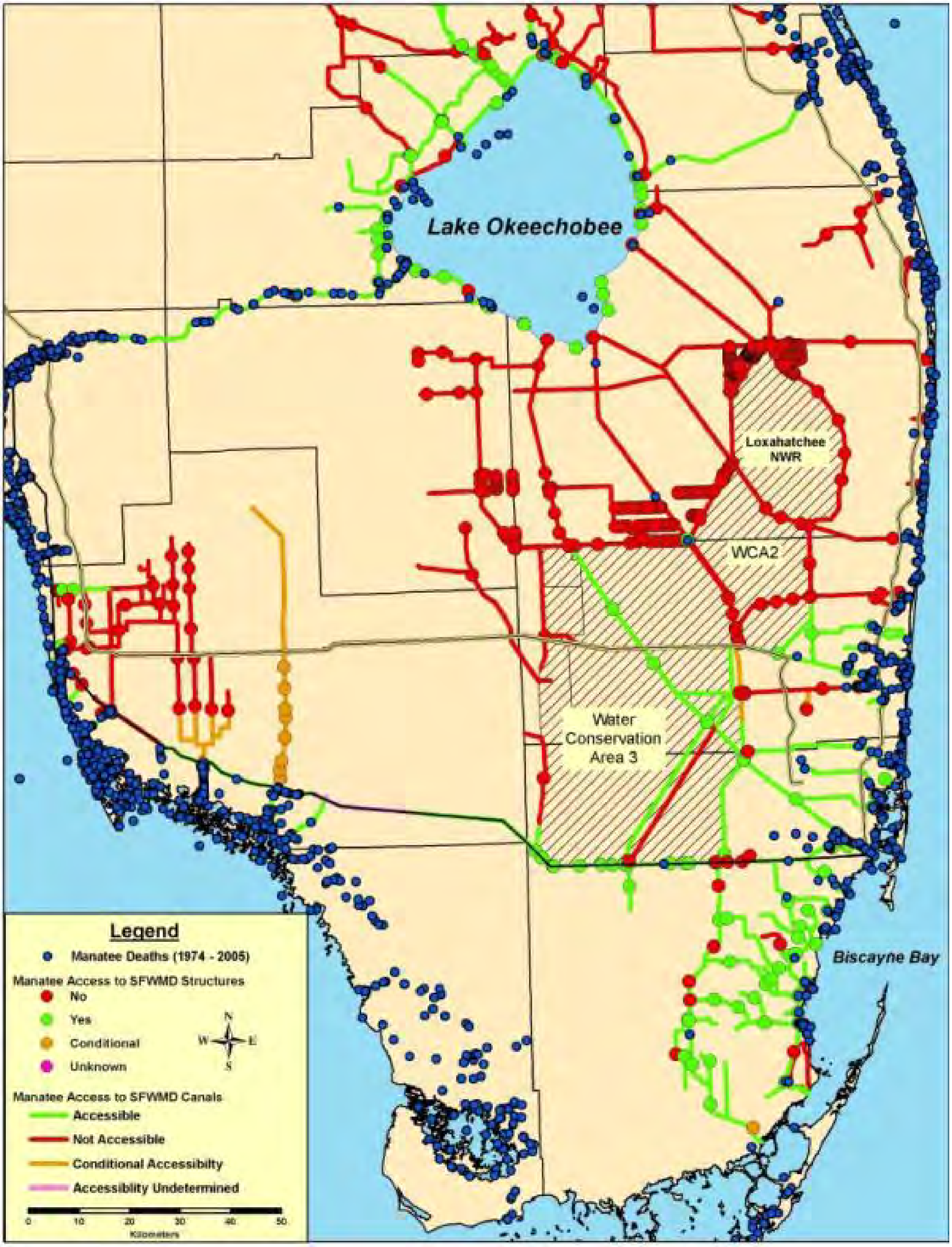


Figure 42: Canals that Florida manatees have access to within ERTP-2016 action area

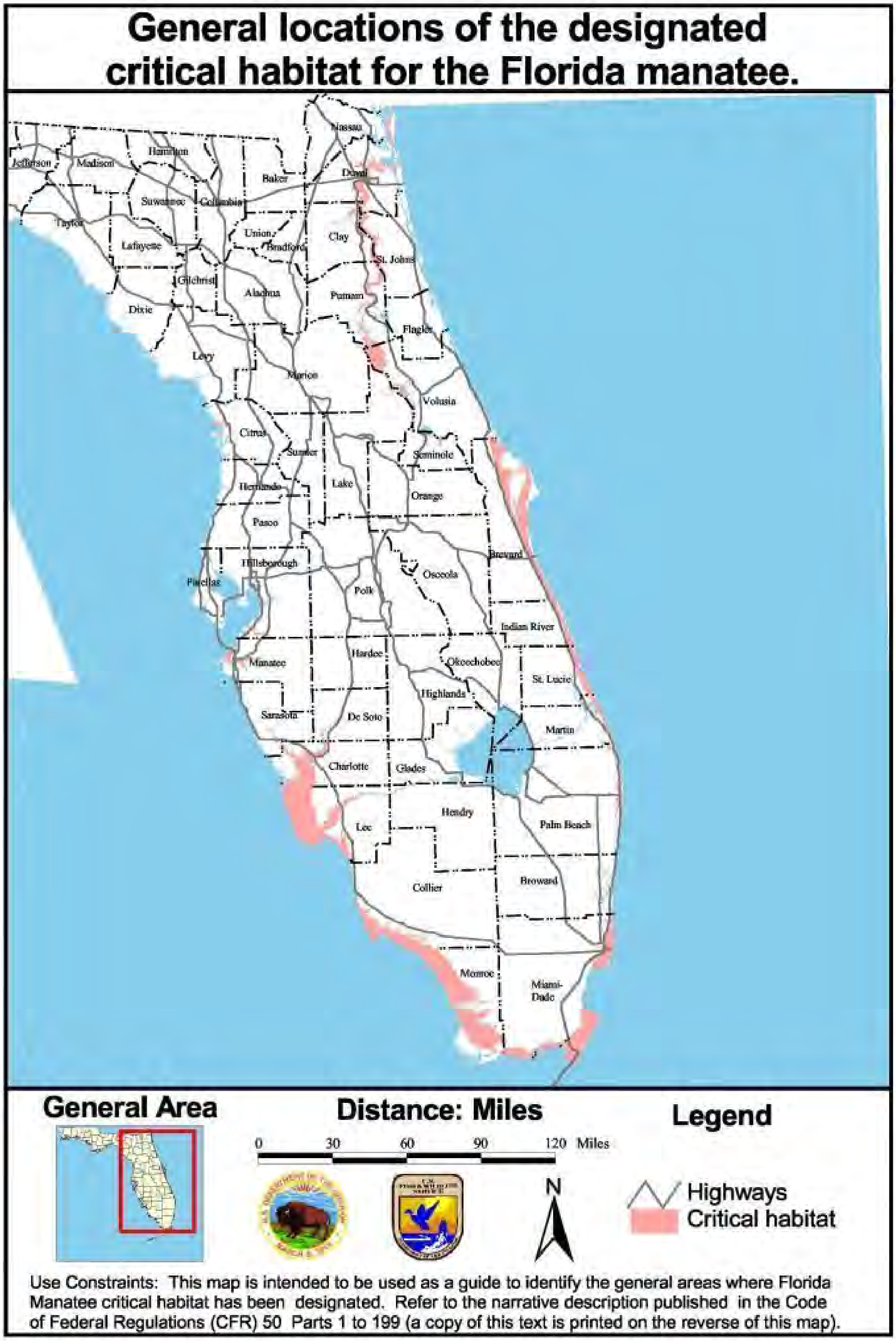


Figure 43: Florida manatee designated critical habitat.

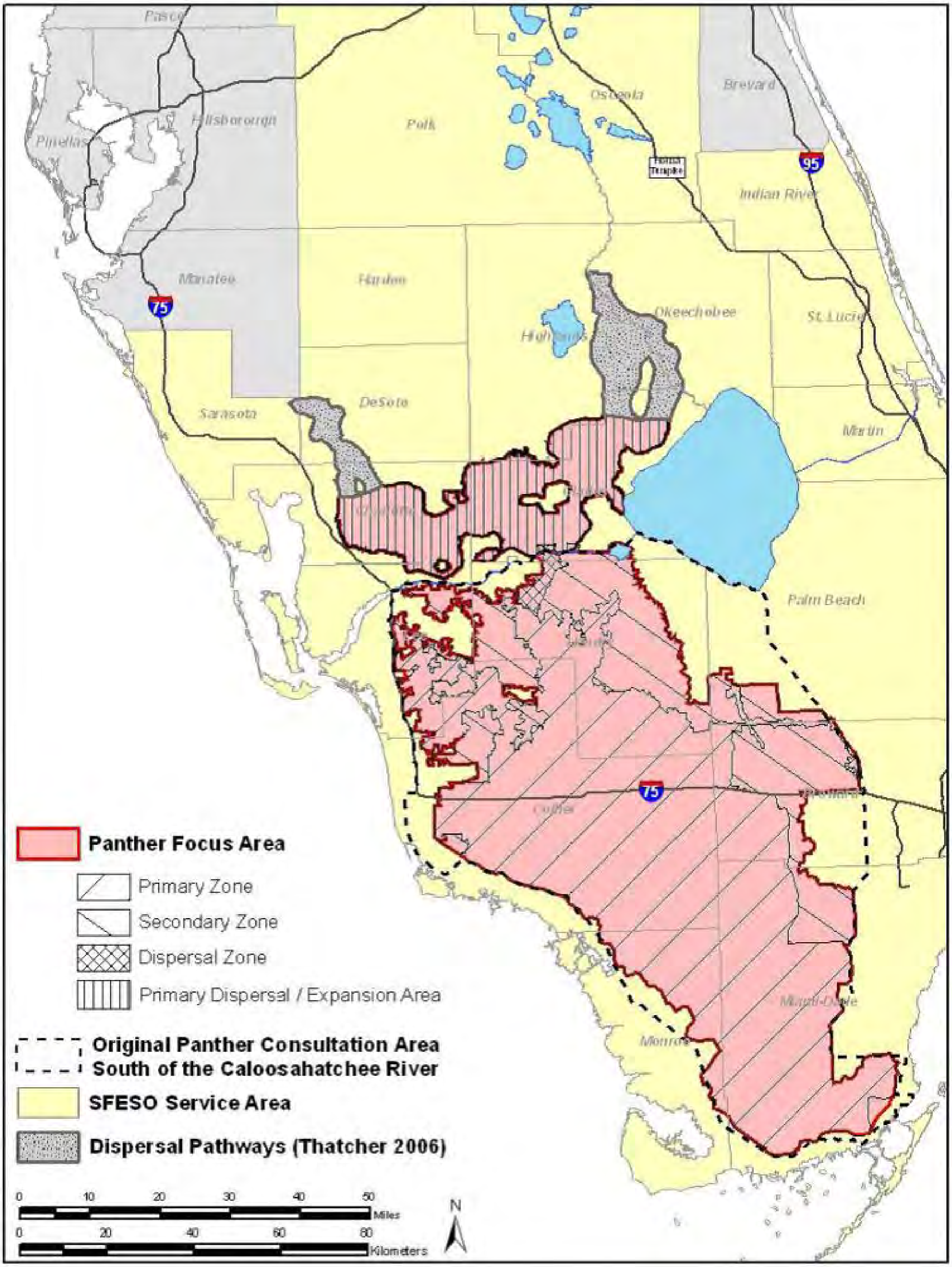


Figure 44: Florida panther focus area map.

Figure 45: Florida bonneted bat consultation area.

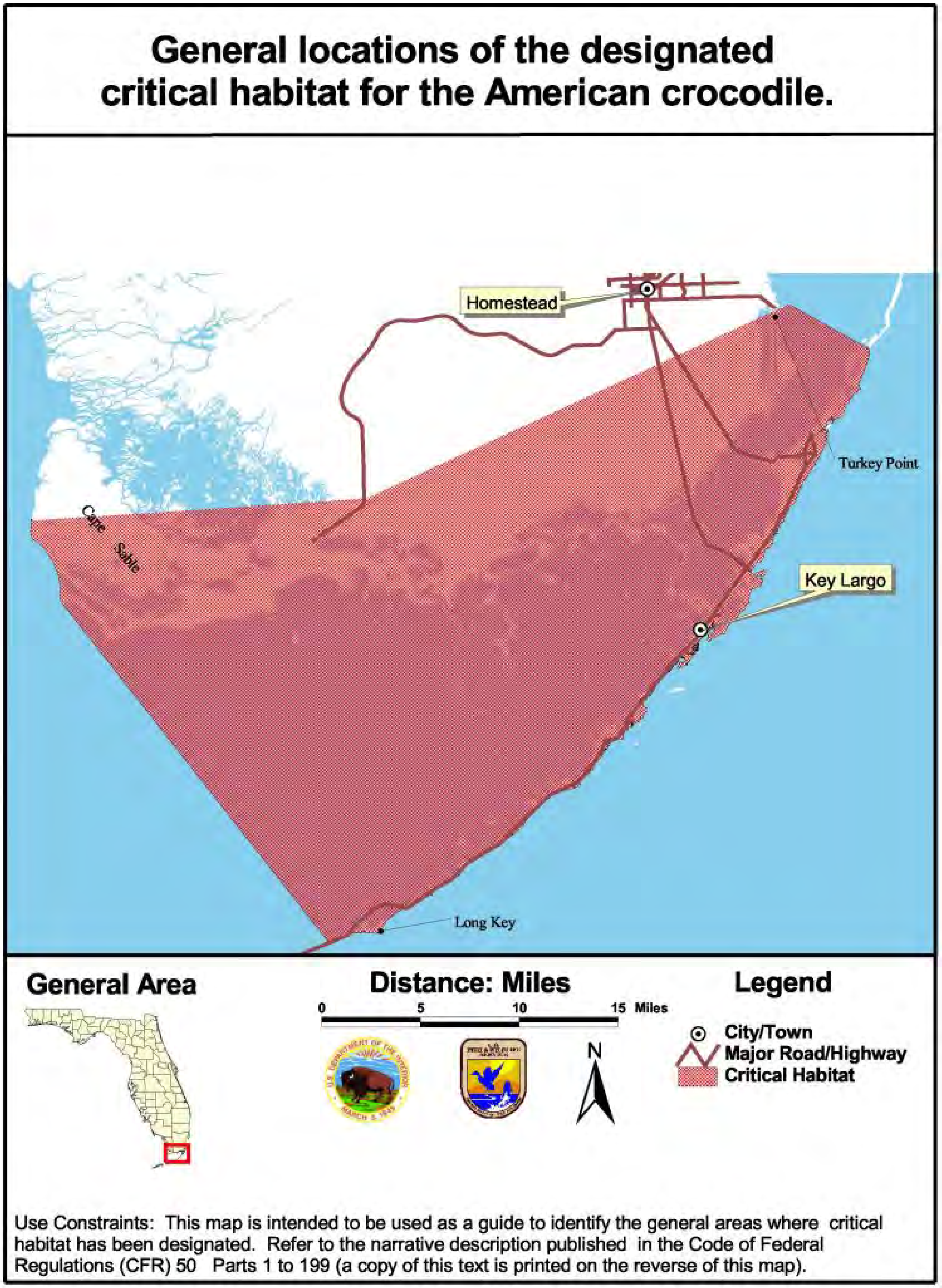


Figure 46: American Crocodile designated critical habitat.

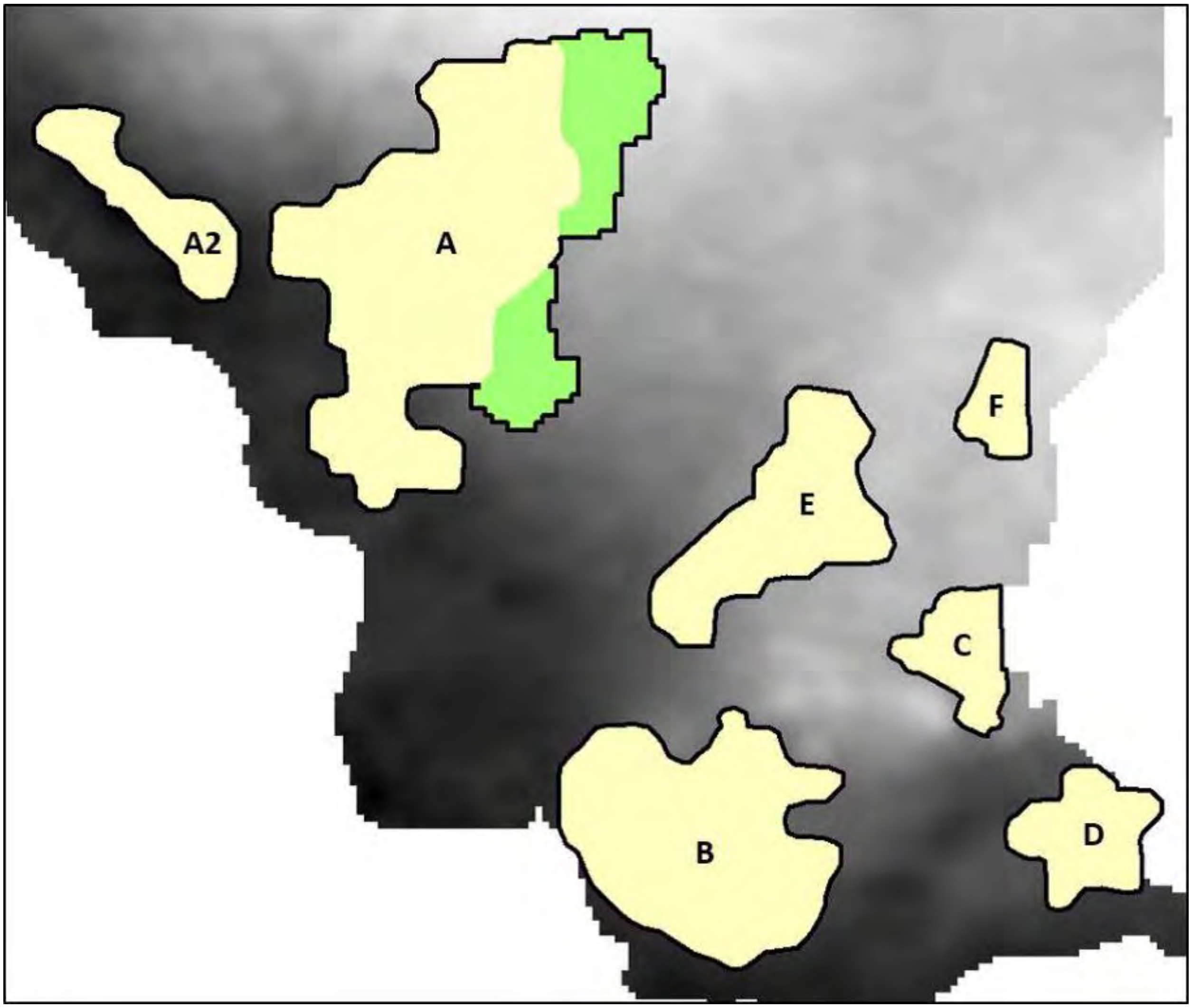


Figure 47: CSSS-A expanded habitat boundary, including portions of tdN and tdS (light green) areas initially modeled and all of CSSS-A delineated original habitat (Figure 8). This CSSS-A expanded habitat area was utilized in an analysis of acreage complying with RPM targets for dry nesting days and discontinuous hydroperiod.

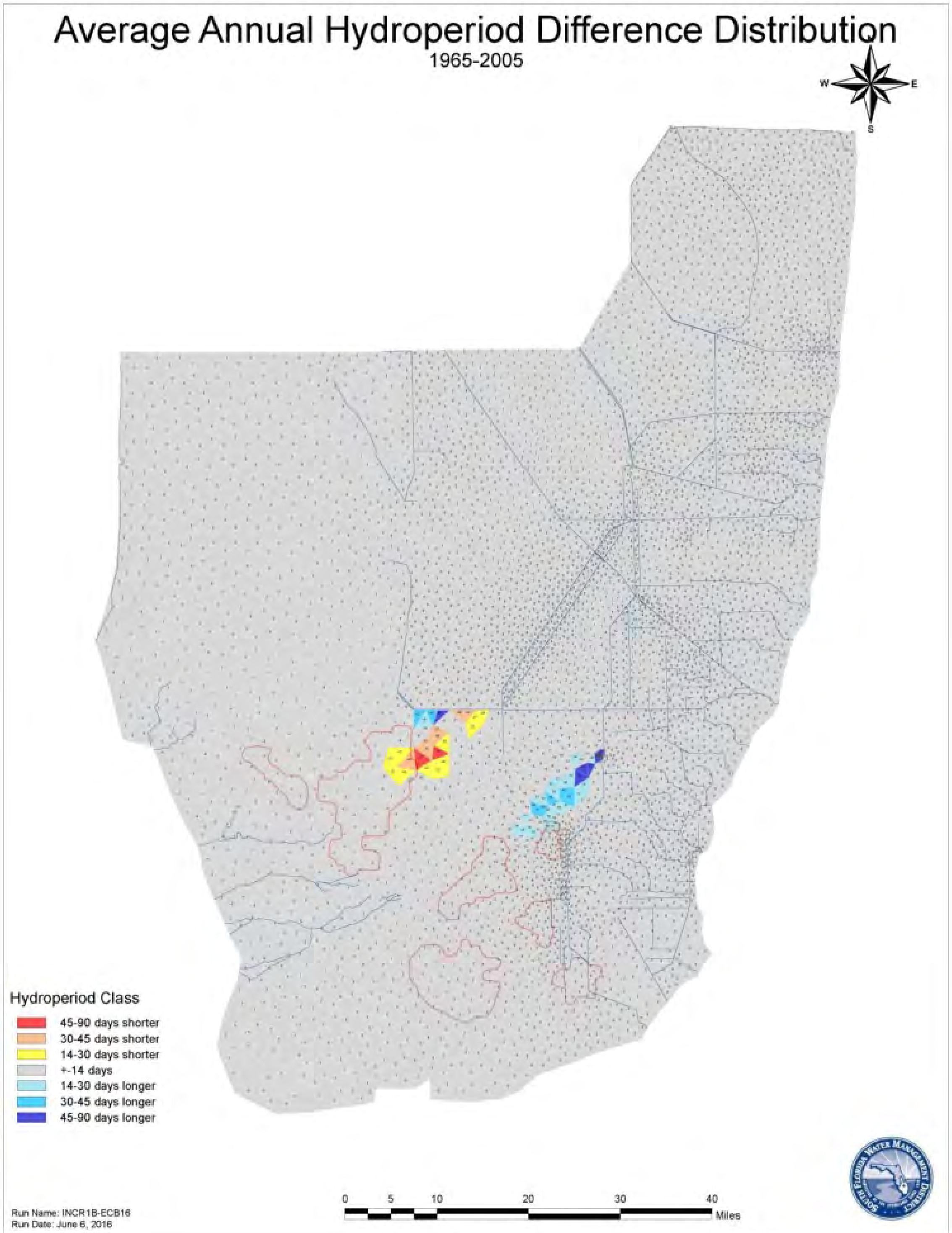


Figure 48: Annual hydroperiod difference expected to occur as a result of the implementation of the RPA (*i.e.*, INCR1B) within the action area.

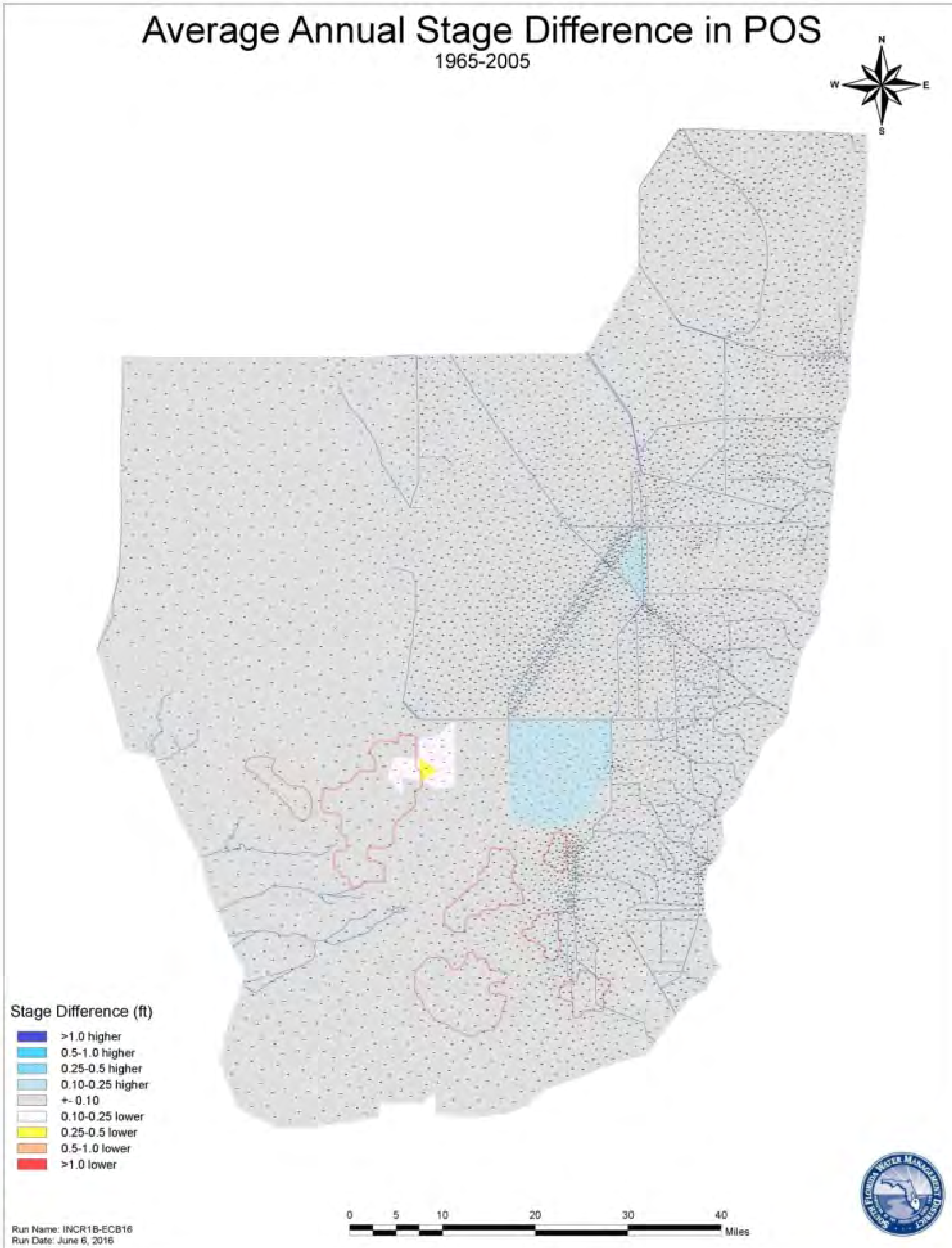


Figure 49: Annual stage difference expected to occur as a result of the implementation of the RPA (*i.e.*, INCR1B) within the action area.

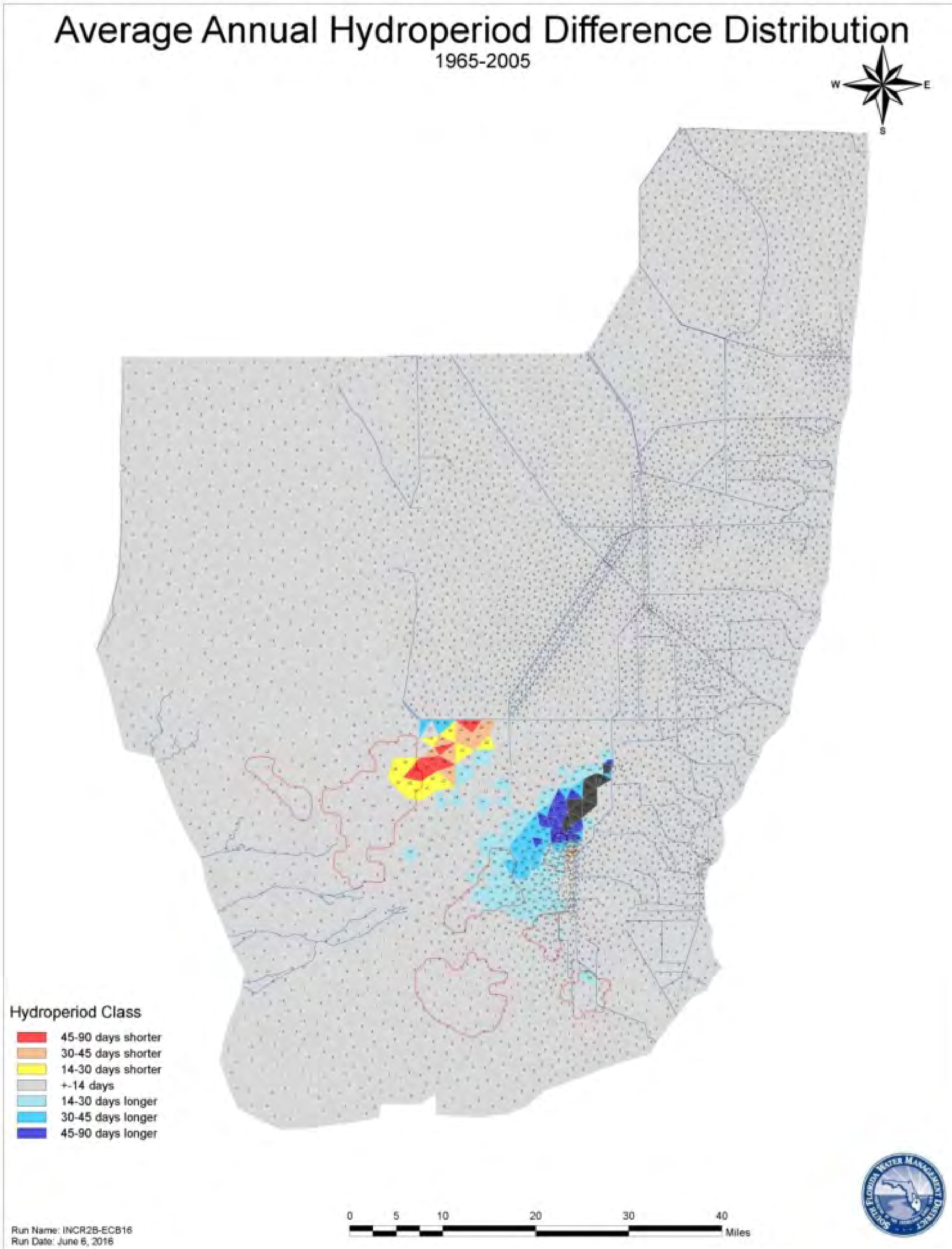


Figure 50: Annual hydroperiod difference expected to occur as a result of the implementation of the RPA (*i.e.,* INCR2B) within the action area.

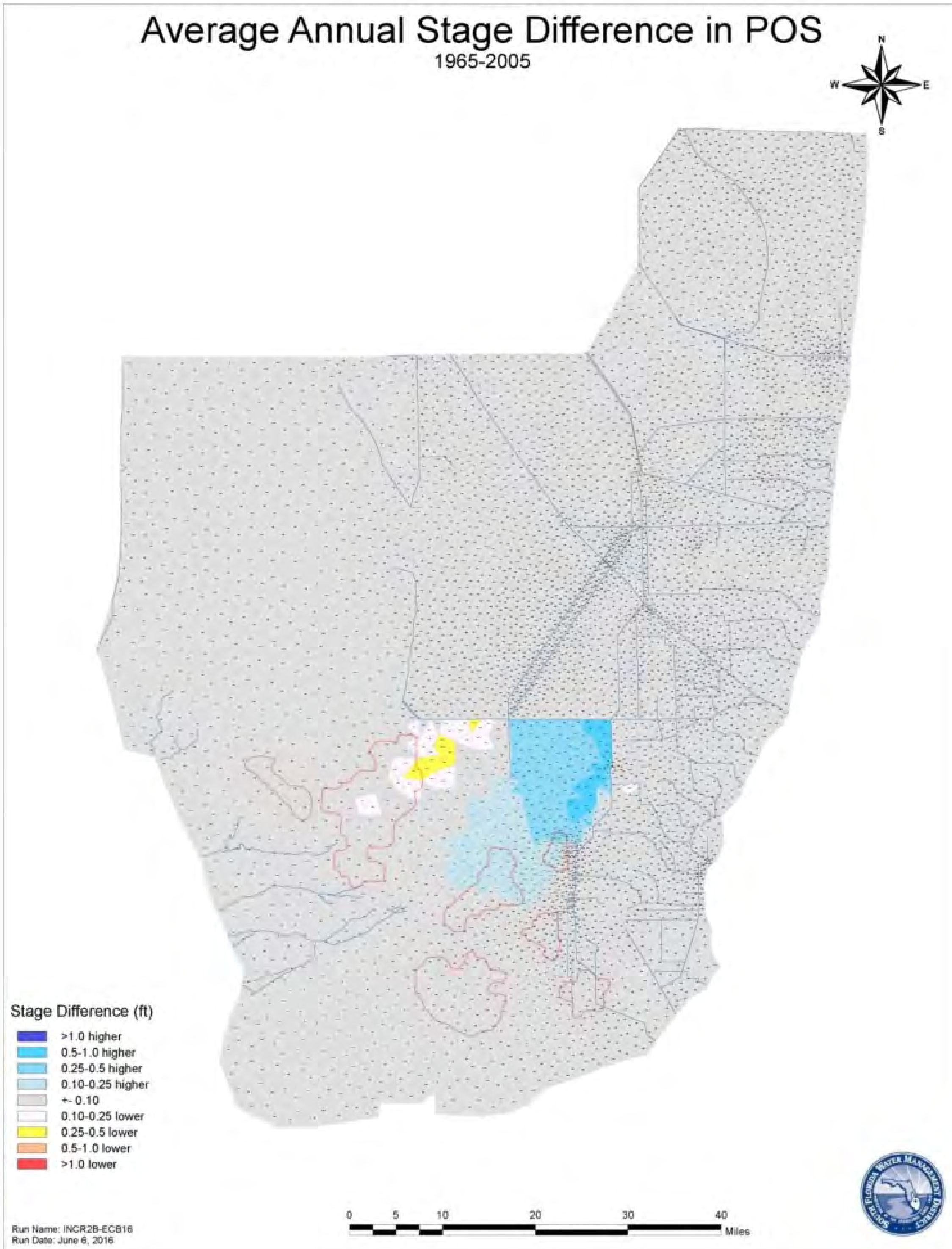


Figure 51: Annual stage difference expected to occur as a result of the implementation of the RPA (*i.e.*, INCR2B) within the action area.

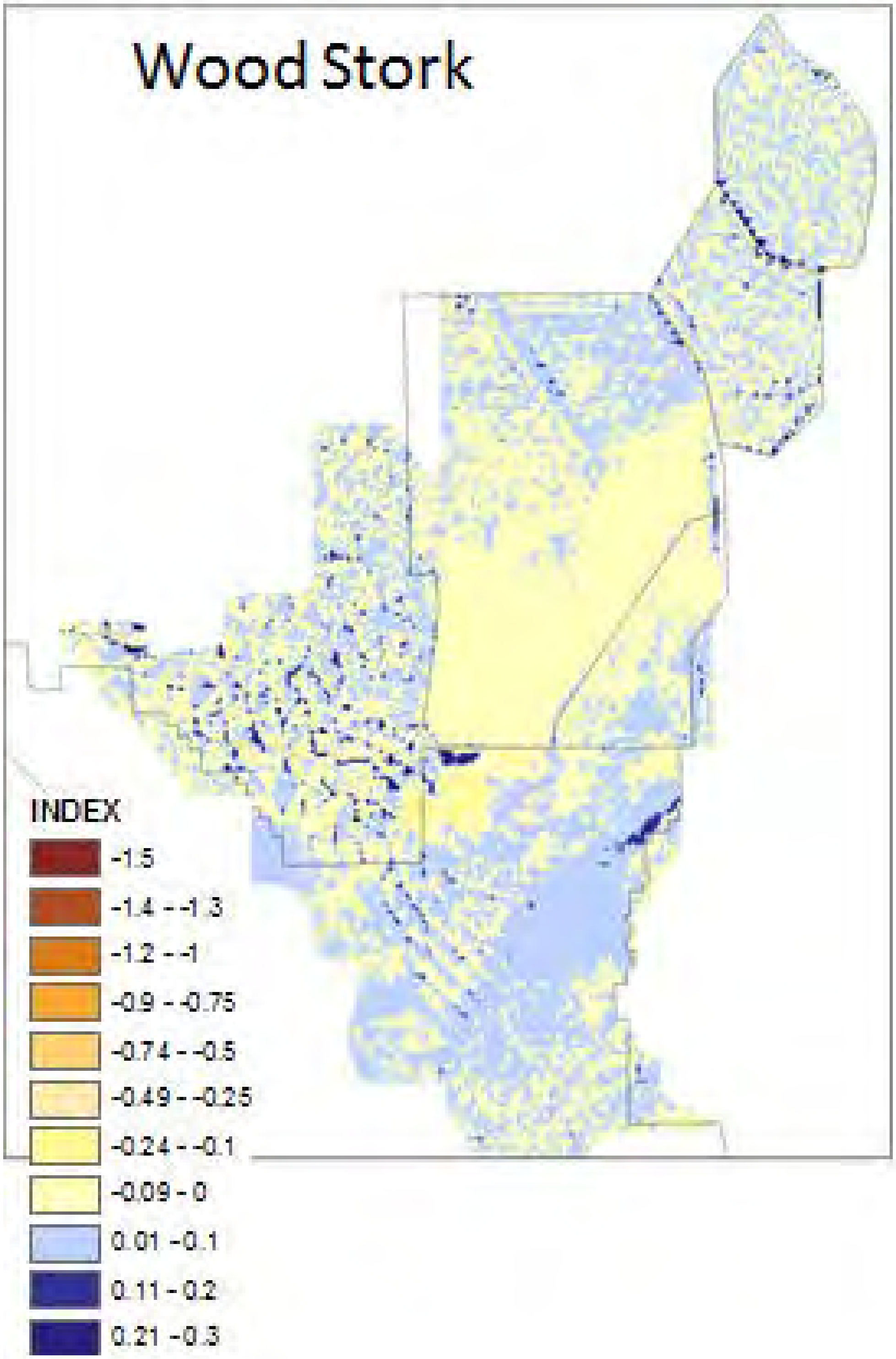


Figure 52: Mean difference in wood stork foraging conditions expected to occur as a result of the implementation of the RPA (*i.e.*, INCR1B) within the action area.

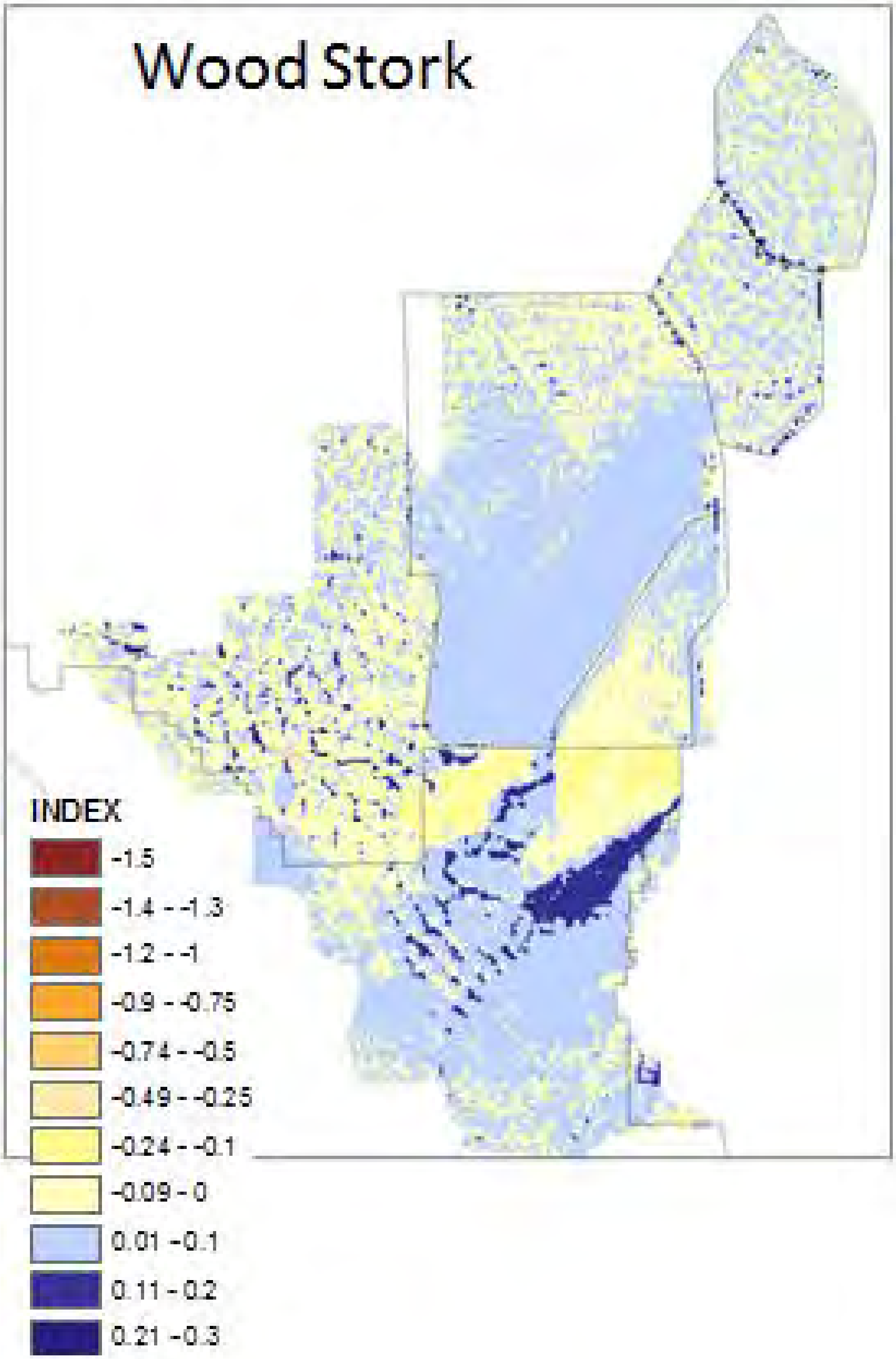


Figure 53: Mean difference in wood stork foraging conditions expected to occur as a result of the implementation of the RPA (*i.e.*, INCR2B) within the action area.

Appendix A - Detailed Consultation History Prior to ERTP-2016

Appendix A
Detailed Consultation History Prior to ERTP-2016

The following actions related to CSSS, Everglades snail kite and wood stork, occurred within the Action Area.

Previous Consultations under pre-IOP Operations

Beginning in March 1983, the National Park Service's Everglades National Park (ENP) management requested restorative action that would reduce the untimely (unseasonal deliveries of water during the dry season) and spatially restrictive (S-12 deliveries only) regulatory releases of water from Water Conservation Area-3A (WCA-3A) into ENP.

The Appropriations Act of 1984, Public Law 98-181 (Section 1302) authorized the Secretary of the Army to conduct an experimental program of water deliveries to ENP. This allowed the U.S. Army Corps of Engineers (Corps) the authority to initiate a series of iterative field tests, with the South Florida Water Management District (District) and ENP concurrence, to collect and analyze hydrological and ecological data.

In 1989, the ENP Protection and Expansion Act incorporated Northeast Shark River Slough (NESRS) (area east of the L-67 Extension) under the protection of the National Park Service.

In 1990, the Corps issued a draft General Design Memorandum (GDM) on the Modified Water Deliveries to Everglades National Park Project (MWD).

In February 1990, the U.S. Fish and Wildlife Service (Service) issued a Biological Opinion for the MWD Project to ENP with a Reasonable and Prudent Alternative (RPA) to preclude jeopardy for the Everglade snail kite (*Rostrhamus sociabilis plumbeus;* hereafter snail kite).

In 1992, the Corps finalized the GDM on the MWD Project to ENP.

In 1993, the Corps implemented Test Iteration 6 of the Experimental Program to ENP.

In May 1994, the Corps issued a Final Integrated General Re-evaluation Report (GRR) and Environmental Impact Statement (EIS) on the C-111 Project.

In May 1994, the Service agreed with the Corps' determination of "no effect" on the C-111 Project for the Everglade snail kite, wood stork (*Mycteria americana*), bald eagle (*Haliaeetus leucocephalus*), eastern indigo snake (*Drymarchon couperi*), American crocodile (*Crocodylus* *acutus*), and Florida panther (*Puma concolor coryi*). However, the Service was unable to evaluate the effects on the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*; hereafter CSSS) beyond construction features and, therefore, could not concur with a "no effect" determination until specific operational criteria were developed.

On June 3, 1994, (mistakenly dated 1993) the Service issued a Biological Opinion on Test Iteration 6 of the Experimental Program to ENP for the CSSS.

In 1995, the Corps extended the duration of Test Iteration 6 of the Experimental Program to ENP. By letter dated September 22, 1995, the Service concluded that Test Iteration 7 of the Experimental Program to ENP was "not likely to adversely affect" the Florida panther, American crocodile, Everglade snail kite, and eastern indigo snake, but that implementation of Test Iteration 7 was "likely to adversely affect" the CSSS and its designated critical habitat, and the wood stork.

On October 27, 1995, the Service issued a Biological Opinion on Test Iteration 7 - Phase 1 of the Experimental Program to ENP for the CSSS with an RPA to preclude jeopardy.

In 1995, the Corps implemented Test Iteration 7 - Phase 1 of the Experimental Program to ENP. Additionally, the Corps initiated a hydrologic and ecological monitoring program for Test Iteration 7 of the Experimental Program to ENP.

On October 17, 1997, the Service requested that the Corps reinitiate consultation on the MWD Project to ENP, the Experimental Program to ENP, and the C-111 Project due to the interdependence and interrelatedness of the projects.

By letter dated November 4, 1997, the Corps agreed to reinitiate consultation on the MWD Project to ENP and the Experimental Program to ENP, but recommended consultation be deferred on the C-111 Project since specific operational criterion were still under development.

In 1998, the Corps implemented an emergency deviation from Test Iteration 7 – Phase 1 of the Experimental Program to ENP for the explicit purpose of protecting listed species in the action area.

On February 19, 1999, the Service issued a jeopardy and adverse modification Biological Opinion on the MWD Project to ENP, the Experimental Program to ENP, and the C-111 Project for the CSSS. This consultation evaluated the effects of construction features only, given that specific operational criterion had not been developed for the three interrelated and interdependent projects.

In 1999, the Corps implemented an emergency deviation from Test Iteration 7 – Phase 1 of the Experimental Program to ENP for the explicit purpose of protecting listed species in the action area.

Between February 1999 and December 1999, numerous interagency meetings and conference calls were held between the Corps, Service, ENP, and the District to discuss implementation of the Service's 1999 Biological Opinion's RPA.

In December 1999, interagency meetings were elevated to the White House Council on Environmental Quality (CEQ) to obtain guidance on National Environmental Policy Act (NEPA) coverage for emergency operations and to facilitate negotiations on points of disagreement between the U.S Department of the Interior (DOI) and Corps. These interagency meetings resulted in the development of the Interim Structural and Operational Plan (ISOP), Emergency Deviation from Test Iteration 7 of the Experimental Program to ENP for protection of the CSSS (ISOP 2000).

In 2000, the Corps implemented the ISOP 2000 emergency deviation.

In April 2000, the Service participated in interagency discussions on ISOP 2000 implementation.

The Service made several recommendations in a planning aid letter to the Corps to improve ISOP 2000. Further interagency discussions led to modifications of the ISOP 2000, resulting in ISOP 2001.

In October 2000, the Corps issued a draft Test Iteration 7 (years 1 through 4) hydrologic monitoring report.

In December 2000, the Corps issued a Supplemental EIS and ROD for the 8.5 Square Mile Area Project (SMA) portion of the Modified Waters Delivery Project to ENP.

In 2001, the Corps implemented the ISOP 2001 emergency deviation.

Previous Consultations under IOP

In February 2001, at the suggestion of the CEQ, the Corps, Service, ENP, and the District engaged the services of the U.S. Institute for Environmental Conflict Resolution (USIECR) to facilitate and mediate the development of an improved hydrologic management plan.

In August 2001, because of the process provided by the USIECR, a collaborative agreement between the Corps, Service, ENP, and the District was reached on a new alternative, the Interim Operational Plan for the Protection of the CSSS (IOP).

In 2001, the Corps issued a Draft EIS for the IOP.

In September 2001, the Corps issued a Draft Supplemental EIS for the IOP.

In December 2001, the District withdrew its support for the IOP, citing flood control concerns. The Corps, District, ENP, and the Service continued to refine IOP to address the District's concerns.

In February 2002, the final recommended plan for the IOP was discussed with the DOI at a meeting with the Corps and District.

On March 15, 2002, the Corps provided a determination that the IOP was "not likely to adversely affect" the CSSS, wood stork, and eastern indigo snake, but may "adversely affect" the Everglade snail kite due to higher water levels in WCA-3A and Florida panthers due to the loss of habitat through the construction of a proposed 500 cfs pump station (S-332C) and three seepage reservoirs associated with S-332B, C, and D Pump Stations. The Corps requested that the Service amend the February 19, 1999, Biological Opinion to consider the IOP as a second RPA to address jeopardy to the CSSS.

On March 28, 2002, the Service amended the 1999 Biological Opinion to include the IOP as a second RPA. The amendment clarified that IOP Alternative 7R represents water management actions that would avoid jeopardizing the CSSS and would not destroy or adversely modify its designated critical habitat. Specifically, IOP Alternative 7R must be implemented in combination with all other RPA components contained in the February 19, 1999, Biological Opinion with the exception of component number 6, requiring the completion and operation of MWD by 2003. The Service also concurred with the Corps' determination that the IOP would "adversely affect" Everglade snail kites and its designated critical habitat in WCA-3A. However, the Service determined that the IOP was not likely to jeopardize the continued existence of the Everglade snail kite or result in the destruction or adverse modification of its designated critical habitat. The Service also concurred with the Corps that the IOP was not likely to adversely affect Florida panthers.

On July 3, 2002, the Corps signed a ROD for the IOP.

On January 25, 2006, the Corps signed a ROD to bridge Tamiami Trail (U.S. Highway 41), a component of the MWD Project to ENP.

On May 10, 2006, the Corps issued a letter initiating the preparation of a supplement to the 2002 Final EIS on the IOP following a March 2006 U.S. District Court order from the Southern District of Florida.

On June 23, 2006, the Service received the Corps' June 22, 2006, Draft Supplemental EIS for protection of the CSSS.

On July 7, 2006, the Corps issued a letter to the Service requesting reinitiation of consultation concerning the IOP Alternative 7R. This letter provided the Service the biological assessment on listed species in the project area necessary to initiate formal consultation under section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) for IOP.

On November 13, 2006, the Corps and the Service agreed via a conference call that proposed CSSS critical habitat (October 31, 2006; 71 Federal Register [FR] 63980) would not be adversely affected by the proposed continuation of IOP.

On November 17, 2006, the Service issued a Biological Opinion on the continuation of IOP. The 2006 IOP Biological Opinion would expire after 4 years on November 17, 2010. Therefore, as a result of the Corps' NEPA process, the IOP was proposed to be in-place until such time as the signing of the ROD for the Everglades Restoration Transition Plan, Phase 1 (ERTP).

On May 5, 2009, the United States Court of Appeals for the Eleventh Circuit issued a ruling on the Incidental Take Statement (ITS) contained in the IOP Biological Opinion issued in November 2006. The Court upheld the Service's conclusion that "the kite will not be jeopardized by its sparrow-saving Interim Plan"; however, it did require the Service modify the ITS, with regards to the snail kite, to include an "adequate trigger for re-consultation and that the trigger be expressed in population terms unless it is impractical to do so." The Service submitted to the Court an amended ITS on November 12, 2009.

On March 10, 2010, the Service issued a second amended ITS in response to technical questions posed by the United States Court of Appeals regarding the WCA-3A high water trigger for snail kites.

On March 19, 2010, the United States District Court for the Southern District of Florida issued an order stating that the amended ITS submitted by the Service on November 12, 2009, was invalid as to the CSSS, and valid as to the snail kite and wood stork. The Service submitted its final amended ITS for the IOP on July 2, 2010.

Consultation History for ERTP

Beginning on June 14, 2009, project team members of the Corps met with the Service to discuss the pending expiration of the 2006 IOP Biological Opinion and next steps for completing ERTP, including a review of IOP effects on threatened and endangered species and their designated critical habitat, potential flexibilities to accomplish ERTP, and to develop a scope for the ERTP.

The Corps and Service, along with members from ENP, the District, and the Miccosukee Tribe of Indians of Florida (Tribe) began conducting weekly meetings in June 2009 to review empirical hydrological, meteorological and ecological data from IOP operations, in order to define an array of water management actions to manage multiple species across the landscape including the CSSS, Everglade snail kite and wood stork. These meetings were replaced with the Periodic Scientist Calls after the implementation of ERTP in 2010.

Additional meetings were held about every other week from July 2009 through May 2010 to coordinate with the District, the Tribe and ENP and other governmental agencies including the Florida Fish and Wildlife Conservation Commission (FWC), Florida Department of Environmental Protection (DEP), Florida Department of Agriculture and Consumer Services, and Miami-Dade Department of Environmental Resources Management.

By letter dated January 21, 2010, the Corps requested a species list from the Service on federally listed threatened and endangered species or their designated critical habitat that may be present in the project study area.

On March 8, 2010, the Service provided a list of federally threatened and endangered species along with candidate species potentially occurring within the project area.

In June 2010, the Corps shared a draft version of the BA for Service review and comment.

On October 15, 2010, the Service received a Final Biological Assessment (BA) from the Corps on the proposed ERTP.

On November 17, 2010, the Service provided its Biological Opinion on ERTP. In it the Service concluded that the proposed project was not likely to jeopardize the continued existence of the CSSS, Everglade snail kite, or wood stork, and is not likely to destroy or adversely modify CSSS or Everglade snail kite designated critical habitat. However, the project would not result in large increases in the number of sparrows within Subpopulation A or large improvements in the condition of habitat in the CSSS subpopulations. The BO was set to expire after 5 years as it was anticipated that the next set of restoration projects would be completed, which were expected to shift flows to the east away from Subpopulation A.

The Corps completed a Draft EIS on the proposed ERTP in March of 2011.

The Corps submitted their Final EIS in December 2011. They concluded that implementation of ERTP is an incremental component in the restoration of habitat within WCA-3A and a step toward multi-species management. This project would provide a means for reducing high water periods and prolonged flooding within WCA-3A, restoring vegetation within the area. Under ERTP, protective levels for the CSSS would be maintained and the implementation of WCA-3A PSCs may enable real-time water management decisions to provide benefits to multiple species within WCA-3A. Therefore, ERTP is expected to contribute to a net beneficial cumulative impact on the regional ecosystem.

On January 24, 2011, the Corps provided an email stating their concerns with the wood stork incidental take triggers as stated in the BO.

On March 2, 2012, the Service provided an amended BO to address Corps concerns with wood stork incidental take triggers. This amendment contained three sections which covered; 1) a flow analysis for up to 100 cfs through S-12A and its effects on CSSS-A; 2) revised graphics and brief discussion regarding snail kites; and 3) a revised incidental take threshold for the wood stork which slightly changed the trigger gauges and time of year when wood stork incidental take analysis is conducted. This section replaced the original incidental take statement for wood storks found in the 2010 ERTP Biological Opinion.

On October 19, 2012, the Colonel Commanding of the Corps signed the ROD for ERTP. It concluded, among other things, that ERTP would provide a means for reducing both high water periods and prolonged flooding within Water Conservation Area 3A, and restore vegetation within the area directly benefitting the Everglade Snail Kite and their primary food source, the apple snail. Further, ERTP protection levels for the Cape Sable seaside sparrow would be maintained and implementation of Water Conservation Area 3A Periodic Scientists Calls would enable real-time water management decisions to provide benefits to multiple species within Water Conservation Area 3A. The ROD also stated that reinitiation of consultation on the next increment of restoration will occur prior to expiration of the ERTP Biological Opinion on January 1, 2016, with the expectation that ERTP will be superseded by a future operational plan. Official ERTP operations began in late 2012.

On November 15, 2011, the Corps in coordination with the public and federal, Tribal, state, and local resource management and regulatory agencies, began planning the Central Everglades Planning Project (CEPP). This project spanned almost the entire Everglades ecosystem from Lake Okeechobee southward and was part of a Nation-wide test of the Corps' new expedited planning process (24 months). The purpose of the CEPP is to assess federal and non-federal interest in implementing the remaining components of the CERP, which was authorized as a framework for restoring the South Florida ecosystem while providing for other water-related needs of the region in the 2000 Water Resources Development Act (WRDA). The main goal is to restore or improve the Everglades ecosystem (including wetlands, uplands, and associated estuaries), water quality, water supply, and recreation while protecting cultural and archaeological resources and values. The current timeline estimates the project completed in 2029 at a rough order of magnitude cost of $1.75B.

On December 17, 2013, the Service issued a Preliminary Biological Opinion on the CEPP. Due to the uncertainty regarding when and how the project would be implemented, the Service provided a Preliminary Biological Opinion that did not provide provisions for incidental take of threatened and endangered species but did describe the anticipated effects of the project. In the future, when predecessor projects are complete and the Corps is closer to constructing portions of the CEPP that will affect listed species, the Service will provide separate consultation document(s) which may authorize incidental take. The Service's preliminary conclusion was that the proposed project would not likely jeopardize the continued existence of the subject species and was not likely to adversely modify critical habitat, where designated. The Service did state its concerns regarding the paucity of benefits to CSSS-A and increased impacts to CSSS-E.

Consultation History for MWD G-3273 Test

Planning for the S-356 Pump Test and the Relaxation of the G-3273 Constraint began in 2014 with 18 meetings, including meetings for kick-offs, hydrologic and hydraulics, ecological monitoring, water quality, and project delivery teams.

On August 29, 2014, the Service responded to a request from the Corps for a table of listed species. On September 2, 2014, the Corps completed the "Modified Water Deliveries to Everglades National Park and the C-111 South Dade Projects Incremental Field Tests and Water Control Plan Update" and released the document to public. This document was followed by the "S-356 Mechanical Pump Test / Increment 0 Report" on October 23, 2014. On November 12, 2014, the Corps completed the "G-3273 Constraint Relaxation / S-356 Field Test and S-357N Operational Strategy" followed by the release of the "Ecological Monitoring Plan" on November 25, 2014.

Section 7 consultation was initiated by the Corps on January 6, 2015. The Service received the Complete Initiation Package (CIP) from the Corps on January 27, 2015. The Service requested that flows through the S-12s be analyzed as part of the monitoring and assessment of project data on February 2, 2015. On February 4, 2015, the Corps sent a letter of FONSI determination to the Service. The Service responded with a letter of concurrence on February 10, 2015. On February 11, 2015, the Corps released their Environmental Assessment and Draft FONSI to the Service. On March 27, 2015, the Corps requested that the Service provide a letter for continued support and concurrence. The Service did so via an email between Lori Miller and James Riley on April 27, 2015. On May 19, 2015, the Service issued a concurrence letter to the Corps stating that the project was not likely to adversely affect threatened and endangered species.

The last project delivery team meeting was on June 30, 2015. Due to the lack of rainfall, the S-356 pump test (Increment 0) occurred periodically during June and July 2015. After significant rainfall fell across the area, Increment 1 began on October 15, 2015.

Additional Projects within the Action Area

In 2000, the MWD-SMA Project proposed the restoration of flows and hydro patterns to NESRS in ENP while providing flood mitigation to the residents and landowners in the adjacent 8.5 SMA through the construction of a flood protection levee and drainage system.

In 2001, the Broward County Water Preserve Areas (WPA) Project, a CERP project consisting of the following components: (1) WCA 3A and 3B Seepage Management Areas; (2) C-11 Impoundment; and (3) C-9 Impoundment was proposed. The proposed actions associated with this multi-component project are the operation of water control structures and the construction of above ground impoundments to: (1) reduce seepage from WCA-3A and 3B and improve hydro patterns within the WCAs; (2) capture untreated runoff currently back pumped from the western C-11 basin into WCA-3A; and (3) pump excess storm runoff from the western C-9 basin into the impoundment and reduce loss of excess runoff to tide.

In 2008, the MWD-Tamiami Trail Project proposed the creation of a 1-mile bridge span of U.S. Highway 41 (Tamiami Trail) between the S-333 and S-334 structures in western Miami-Dade County, Florida, by removing up to a mile of the existing highway, embankment, and associated culverts.

In 2008, actions were taken to alleviate high water in WCA-3A caused by Tropical Storm Fay. These actions were outlined during a meeting of State and Federal agencies called together by Commissioner Ron Bergeron of the FWC. The desired goal was to lower stages in WCA-3A by 1 ft in 30 days and by 2 ft in 60 days, if possible. Actions were categorized into immediate and longer-term actions that would need more coordination. The immediate actions included:

(1) continuation of discharge to tide as capacity allowed; (2) reduction of inflows to WCA-3A at the S-11s; (3) maximization of flows out of WCA-3A and 3B while maintaining an 8.0-ft NGVD stage in L-29; (4) increasing flows from WCA-3A to 3B through S-151; (5) discharging through S-197 to create storage in SDCS for WCA-3A water; and (6) gapping the old Tamiami Trail. The other items discussed that required additional analysis and NEPA coordination included: (1) temporarily raising the G-3272 constraint; (2) using the S-356 to capture seepage in conjunction with raising the G-3273 constraint; (3) gapping the L-67A levee; (4) breaching the L-67 extension levee; (5) sandbagging Shark Valley Tram road culverts; (6) delaying the S-12A closure; and (7) clearing of vegetation south of Tamiami Trail culverts. Some of the immediate actions were implemented quickly while others were delayed for various reasons. As a result, the intended system response was slow to materialize and after 30 days of implementation, the 3AVG water level receded by 0.6 ft. Eventually, all of the immediate actions were in place and in conjunction with the cessation of rains, the water levels receded to 10.5-ft NGVD by December 20, 2008, which represented a total decrease of 1.25 ft in 60 days.

In 2009, the C-111 Spreader Canal Project proposed the construction and operation of a spreader canal with water control structures to establish a hydraulic ridge between Taylor Slough and the C-111 Canal to reduce seepage loss from Taylor Slough and its headwaters. Establishing this hydraulic ridge will (1) restore the quantity, timing, and distribution of water delivered to Florida Bay via Taylor Slough to historic levels as derived from the pre-drainage model runs; (2) improve hydroperiods and hydro patterns in the Southern Glades and Model Lands; and (3) return coastal zone salinities to historical recorded conditions through the redistribution of water that is currently discharged to tide. This project was anticipated to have minor effects on CSSS habitat located in the vicinity of subpopulations C and D within the Action Area (Service 2009a).

In 2009, the Biscayne Bay Coastal Wetlands Phase 1 Project proposed the construction and operation of flow-ways designed to restore freshwater flow to the coastal wetlands of Biscayne Bay.

In 2010, Phase 1 rock mining in the Lake Belt Mining Area (LBMA) was submitted for consultation. The proposed action to mine limerock for 20 years would impact about 7,351 wetland acres, while preserving and enhancing about 4,590 wetland acres. The Service determined the project would adversely affect the wood stork and exempted incidental take for the wood stork based upon the loss of 7,351 wetland acres and the estimated loss of 58 nests (75 nestlings) over the 20-year life of the project associated with the loss of various hydroperiods. The Service concluded the proposed action would not jeopardize the survival and recovery of the wood stork.

In 2010, Alternative 8 programmatic consultation to rock mine in the LBMA was submitted. The proposed action to mine limerock for 30 years would impact about 13,965 wetland acres, while preserving and enhancing about 6,377 wetland acres. The proposed action also included hydrological seepage mitigation of wetlands within portions of the LBMA and adjacent public lands in ENP and WCA-3B. The Service determined the project would adversely affect the wood stork and exempted incidental take for the wood stork based upon the loss of 13,965 wetland acres and the estimated loss of 200 nests (258 nestlings) over the 30-year life of the alternative. The Service concluded the proposed action would not jeopardize the survival and recovery of the wood stork. The Service noted that, over the 30-year life of the alternative, the proposed action could provide an estimated gain of 931 nests (1,201 nestlings) resulting from the protection and enhancement (exotics removal) of wetlands within specific hydroperiods.

In 2010, the 2009 Omnibus Appropriations Act directed the Secretary of the Interior, acting through the National Park Service, to immediately evaluate the feasibility of additional bridge length, beyond that to be constructed pursuant to the MWD Project, including a continuous bridge, or additional bridges or some combination thereof, for the Tamiami Trail to restore more natural water flow to ENP and Florida Bay for the purpose of restoring habitat within ENP and the ecological connectivity between the ENP and WCAs. This project is known as the Tamiami Trail Modifications: Next Steps Project.

BACKGROUND

As evidenced by the lengthy consultation history above and at the beginning of this document, the issue of restoring flow through a fragmented Everglades ecosystem and how this may affect threatened and endangered species, especially with regards to the Cape Sable seaside sparrow (CSSS), is not new. It became clear in the late 1980's that steps were needed to help restore natural hydrologic conditions within Everglades National Park. The completion of the L-67A and C levees, part of the Central and South Florida Project, were shunting too much water towards western Shark River Slough while the historic flow path from Water Conservation Area (WCA) 3B to northeast Shark River Slough was being starved for water. This is still the case today.

A solution to this problem was first proposed by the U.S. Army Corps of Engineers in its General Design Memorandum of 1990. In it there were five major modifications considered: 1) structures in the L-67A to allow water to pass from WCA-3A to 3B; 2) structures in L-29 to allow water to pass from WCA-3B to northeast Shark Slough; 3) removal of L-67 extension and backfilling the canal; 4) construction of a protective levee around the 8.5 Square Mile Area (8.5 SMA); and 5) installation of two seepage control and discharge pumps to move water out of the protected area (Davis and Ogden 1994). This plan later became known as the Modified

Water Deliveries to Everglades National Park (MWD) and has yet to be completed as designed. It has been the Service's long-standing opinion, as well as other Everglades experts, that completion of the MWD project in conjunction with the other projects in the CERP will benefit all of the threatened and endangered species within the Everglades ecosystem.

The Service has intervened on behalf of the Cape Sable seaside sparrow on several occasions, the first of which was in 1995. The Service concluded that Test Iteration 7 of the Experimental Program of Water Deliveries to Everglades National Park would jeopardize the continued existence of the Cape Sable seaside sparrow. This program of deliveries would continue the uneven and unnatural discharge of water across Tamiami Trail and negatively impact sparrows to the west of Shark Slough (Subpopulation A) with too much water and impact sparrows to the east of Shark Slough with too little water. The Reasonable and Prudent Alternative (RPA) suggested by the Service included, among other things, that water flows through the S-12 structures be distributed in a manner that restores and maintains the short hydroperiod of the marl prairies and sloughs west of Shark River Slough.

A series of meetings between the SFWMD, Corps, BCNP, ENP and the Service took place to discuss options that could achieve the goals identified in the BO of reducing surface water levels in the western marl prairies as quickly as possible and keeping the area dry during the nesting season. Options identified included closing structures S-343A, S-343B, S-344, S-12A and S-12B, and routing excess flows through S-333; degrading the L-67 extension; moving water normally going into WCA-3A to the east through the Miami Canal and L-30; resuming the pilot test for L-67, and reducing flows destined for WCA-1 and WCA-2A by moving water to the east. In addition to these actions, the completion of the 'foundation' MWD project was considered key in creating suitable hydrologic conditions for the sparrow. Various portions of these actions were carried out, including some other emergency actions for protection of the sparrow; however, conditions did not improve which lead to the next Biological Opinion issued by the Service in 1999.

The Service concluded in its February 19, 1999, Biological Opinion that continuation of the Experimental Deliveries project (discharging excessive water into western Shark Slough) would jeopardize the continued existence of the CSSS. The RPA included, among other items, the immediate protection of a minimum amount of CSSS habitat from unusually high/low water levels and completion of MWD project by 2003. In late 2001, the Corps offered their RPA which was the annual closure of the S-12A, B, C and S-344 and S-343 A and B. This plan, which is more or less still in place under ERTP, was developed to achieve the minimum protection measures performance (i.e., 60 continuous dry days during the nesting season over a minimum of 40 percent of subpopulation A) however, it has only achieved moderate success. These minimum protection measures were expected to keep the CSSS extant until MWD and

CERP could be implemented. However, the minimum 60 day nesting requirement has only been met in 10 of the last 14 (71 percent) years while the habitat requirement of 90 to 210 day annual discontinuous hydroperiod has rarely been met in subpopulation CSSS-A.

In 2002, the Corps requested the Service consider the Interim Operational Plan (IOP) for the Protection of the Cape Sable Seaside Sparrow IOP-Alternative 7R (Alt-7R) as a second RPA for water management actions to avoid jeopardy to the Cape Sable seaside sparrow in compliance with the 1999 Biological Opinion. The Service concluded that while this alternative afforded the same protections to CSSS as the original RPA, it did little to address the ponded water depths in the southern and eastern portions of WCA-3A. Rather, IOP Alt-7R would maintain historically deep, impounded pools that degrade snail kite nesting habitat through the loss of woody vegetation in southern and eastern WCA-3A, and degrade foraging habitat due to the loss of wet prairie communities. This loss of nesting substrate and foraging habitat was expected to adversely affect snail kites by reducing the reproductive potential of snail kites using this area.

While the Service concluded that IOP was likely to adversely affect snail kites it found that it was not likely to jeopardize its continued existence or destroy or adversely modify designated snail kite critical habitat. Incidental take was provided and expected to occur until the Combined Structural and Operational Plan (CSOP) could be completed in 2007. Reasonable and Prudent Measures (RPM) included, among other things, that within the operational flexibility provided by IOP, the Corps must adjust day-to-day operations to minimize adverse effects to snail kites by reducing durations and depths of high water within southern and eastern WCA-3A as much as possible without increasing adverse effects to the Cape Sable seaside sparrow. Factors to be explored in accomplishing this included: 1) reduction of inflows to WCA-2A; 2) increased capacity of outflow structures from WCA-3A that will not increase harm to sparrow habitats; and 3) reduction of inflows to downstream areas, thereby creating increased capacity and getaway potential for release of WCA-3A flood waters.

In 2003, the Service convened an independent panel of avian ecologists to review the current species data and restoration plans in relation to several avian species within the Everglades. The Service wanted a “fresh look” at the species status and the restoration strategies to make sure that what was being planned would provide adequate conservation lift for all of the wildlife in the Greater Everglades. Their final report (Sustainable Ecosystems Institute [SEI] 2003) concluded several things worth mentioning here. First, they concluded that there are strong indications that restoration to near- or nearer-natural water flows through the system will ultimately benefit not one or a subset but all of the target species. This conclusion signifies that there are no obvious trade-offs in the sense of projected actions benefiting one or some species of the multi-species complex while being deleterious to others. Second, they conclude that while ecosystem manipulations at the proposed scale can never be completely without risk, the Panel viewed

CERP as a necessary step to take the present, degraded system to an improved level of functionality. Lastly, the panel stated that uncertainties during the transition process and thereafter must be countered by extensive and careful monitoring of species' responses, and by adaptive management of those process elements under management control to ameliorate negative impacts. Monitoring results will need immediate "real-time" evaluation, such that potential negative impacts can be identified and redressed promptly (SEI 2003).

On May 10, 2006, the Corps issued a letter initiating the preparation of a supplement to the 2002 Final Environmental Impact Statement (FEIS) on the IOP following a March 2006, U.S. District Court order from the Southern District of Florida. On November 17, 2006, the Service issued a Biological Opinion on the continuation of IOP. The 2006 IOP Biological Opinion was set to expire after 4 years on November 17, 2010, when it was anticipated that MWD would be complete and the CSOP fully implemented. Therefore, as a result of the Corps' NEPA process, the IOP was proposed to be in-place until such time as the signing of the Record of Decision (ROD) for the Everglades Restoration Transition Plan, Phase 1 (ERTP). In the 2006 BO the Service concluded that the continued operation of IOP for four years was expected to remain consistent with the RPA in the Service's 1999 Biological Opinion. Accordingly, the Service anticipated reduced water levels during sparrow nesting season to a level that would allow adult sparrow pairs to complete one or two successful clutches in most years. Large increases in the number of sparrows within Subpopulation A or large improvements in the condition of habitat in the area were not expected to occur under IOP. However, the continued operation of IOP, designed to avoid jeopardizing the Cape Sable seaside sparrow, was anticipated to sustain Subpopulation A, which is necessary for overall population health.

While the Service concluded that continuation of IOP for four more years was not anticipated to appreciably reduce the likelihood of survival and recovery of the sparrow, it did anticipate several new projects would come on line quickly to help provide suitable conditions for sparrows. These projects were expected to provide more operational flexibility in the system over the upcoming years. The 8.5 SMA Project, scheduled to be completed in 2007, was expected to provide more operational flexibility to move water from WCA-3B to northeast Shark River Slough (NE Shark Slough) in order to restore a more natural distribution of flow across Tamiami Trail. Additionally, it was expected at the time, that the ROD for the Combined Structural and Operational Plan (CSOP) would be completed in early 2008. However, the CSOP would not be fully implemented until completion of the MWD – Tamiami Trail Project, which was scheduled to be completed in 2010 or early 2011. The IOP was anticipated to be in place until the CSOP was fully implemented but the development of CSOP was stalled and it was eventually put on hold in 2009.

During the review of the Critical Habitat Designation for the CSSS in 2007, the Service did not designate CSSS-A as critical habitat (72 *Federal Register* [*FR*] 62736). The Service found that the benefit of excluding CSSS-A outweighed the benefit of including it. It was also thought that in not designating it as critical habitat it would give the Corps more operational flexibility while rapidly trying to meet its obligations to implement MWD and other CERP projects that were being planned.

Also in 2007, the Service sponsored another panel of external avian ecologists to again review the most current data and strategies for restoring the Everglades while maintaining all of the imperiled species that inhabit it. Several of the conclusions from their final report (SEI 2007) are profound and are excerpted below:

> *The panel recognizes that some controversy persists over the importance of water flow versus water levels in shaping the Everglades. However, the material we examined presents a compelling argument for water flow being absolutely central to restoring the 2 defining characteristics of the Everglades. Every effort should be made to move forward both Modified Water Deliveries to Everglades National Park (ModWaters) and Water Conservation Area 3 Decompartmentalization and Sheet Flow Enhancement (Decomp).*
>
> *An overarching conclusion of the panel is that the Status Quo is not an option if the goal is to restore the ecosystem and prevent the extinction of critically endangered species. Incomplete implementation of emergency measures and failure to complete more major plans in a timely way increases the risks to endangered species. Moreover it makes it more difficult and more expensive to recover them.*
>
> *Since the declines of the mid-1990s the population as a whole has been stable. But trends are not uniform across geographic areas. Subpopulation A has continued to decline, despite emergency measures to sustain it, and is currently less than 5% of its size in 1981/1992. Subpopulations B and E, the two remaining large populations, have been stable with an estimated 2500-3000 sparrows constituting 80-90% of the total population. Subpopulation C remains small but is the only one that has increased since the mid-1990s. Subpopulations D and F are the smallest and arguably on the verge of extirpation (since 2000, only 1-3 singing males have been detected).*
>
> *The panel concludes that under current conditions the Cape Sable Seaside Sparrow population is sufficiently small and its range is sufficiently restricted that*

it is vulnerable to environmental stochasticity (which can lead to extirpation). Moreover the likelihood of the population increasing under current conditions seems remote.

The 2003 SEI panel concluded that implementation of Comprehensive Everglades Restoration Plan (CERP) will benefit the sparrow. This conclusion has not changed. However the fundamental problem is not simply whether CERP will benefit the species but rather whether CERP will be implemented properly and in time to ensure the survival 3 of the species. Ongoing failure to carry out measures fully and in a timely way (identified by scientists in several studies and previous panels) has not been resolved. In some cases, short term management has become long term management because no progress has been made in restoring flows to historic patterns in areas occupied by endangered species.

Perhaps the most startling information presented to this panel was that emergency management (i.e. Interim Structural and Operational Plan (ISOP)/ Interim Operational Plan (IOP)) designed to alleviate the pressure on sparrows have not produced desired hydrologic conditions. It is notable that where management goals have been met (e.g. (NP-205)) the population has responded positively. But elsewhere water levels have been detrimental to the population. Numbers have continued to decline especially in areas of unanticipated flows.

In January of 2010, the IOP BO expired, as it was anticipated that the next major installment of projects would be in place by this time. Instead, the Corps and Service collaborated on the Everglades Restoration Transition Plan or ERTP. This would be the first in an anticipated series of multi-year projects to help transition into CERP in a way that would have the least impact to imperiled species in the system. ERTP is a modification of the IOP with additional operational flexibilities to provide hydrological improvements primarily in WCA-3A (the S-12C closure for protection of the CSSS was eliminated, as well as a lowering of WCA-3A regulation schedule by 0.25 foot), while maintaining conditions south of Tamiami Trail, until full implementation of the Combined Operational Plan (COP) and ultimately the CERP. ERTP was intended to serve as a transition between IOP and COP. However, it should be understood that at the time (2010) there were limited opportunities within the existing Central and Southern Florida Flood Control (C&SF) Project infrastructure to realize anticipated Everglades restoration benefits, such as reconnecting WCA-3A, WCA-3B, and Northeast Shark River Slough (NESRS). Therefore, ERTP was expected to result in small but ecologically meaningful hydrologic improvements in WCA-3A until such time as the historic flow way could be re-established. It was expected to maintain the status quo for the CSSS.

Consistent with past evaluations, the Service concluded that maintaining and restoring sparrow subpopulation A is essential to maintaining the overall sparrow population. Because it is isolated and geographically separated from the other sparrow subpopulations, it provides the greatest protection from the risks associated with local catastrophic events. Additionally, since it has the potential to support large numbers of sparrows, it can contribute to improved population resiliency more than any other subpopulation. The extirpation of subpopulation A would represent a significant reduction in the distribution of the sparrow, and would be the most challenging area in which to restore a self-sustaining subpopulation (Walters et al. 2000).

It was anticipated that ERTP would provide reduced water levels during sparrow nesting season to achieve a level that would allow sparrow pairs to complete one or two successful clutches in most years. This level of protection was believed to be sufficient to maintain Subpopulation A for the short term (five years) or until such time that additional CERP projects could be brought on-line, but it was not expected to improve the status of this subpopulation.

Again, the Service required that the Corps meet the minimum requirements for nesting conditions in CSSS-A (60 dry nesting days as measured at NP-205 water levels below 6.0-ft). Reasonable and Prudent Measures (RPM) included operational flexibility during the continuation phase of the IOP and during the implementation of the ERTP to minimize impacts related to hydrology. During periods when water regulations are not restricted by constraints, the Corps would work with the Service and other partners to identify operations that minimize detrimental impacts or reduce the future risk of detrimental impacts to the CSSS, Everglade snail kite, wood stork, and their habitats. The second RPM was to obtain further information about the effects of ERTP and develop appropriate measures to further minimize impacts to CSSS, Everglade snail kites, and wood storks. The first Term and Condition written in the 2010 Biological Opinion was for the Corps to initiate the planning process to begin field testing and relaxing or removing the existing G-3273 gauge constraint of 6.8 ft NGVD which governs wet season utilization of S-333. The first phase of this 3-year testing protocol has just begun as of October 2015.

The ERTP Biological Opinion expires in January 2016, and the Corps and Service have been formally consulting on its replacement. Unfortunately, no operational changes have been proposed in this next phase of ERTP. This being said, it has become evident over the last 14 years since IOP was implemented, that continuing to maintain the sparrow population until the Everglades restoration projects can be completed is not sustainable (see Environmental Baseline and Effects of the Action in this document). Increased effort needs to be taken to quickly rectify the altered hydrology in the Greater Everglades that is negatively impacting several fish and wildlife species, as well as, Everglades National Park.

Consultation History for the Everglade Snail Kite

In addition to the list of consultations on actions affecting the snail kite in the WCAs and ENP in the Consultation History section of this Biological Opinion, the Service has evaluated impacts of past Federal actions in accordance with the Act throughout the species' range, including Lake Okeechobee, St. Johns Marsh, Kissimmee River, and the KCOL and WCA 2A in the greater Everglades.

Only two Biological Opinions in our records reached a conclusion that a proposed action was likely to jeopardize the continued existence of the snail kite. The first was in response to the Corps' Regulatory Program regarding a Clean Water Act (CWA) Section 404 wetland fill permit for a private housing development, Ibis Landing, in Palm Beach County. The October 22, 1986, Biological Opinion called for redesigning the proposed project to avoid impacts on wetlands known to be of great importance as habitat for the snail kite, although these wetlands were not in the designated critical habitat for the species. The permit was issued with a modified design protecting the most important snail kite habitat on the property.

The second jeopardy Biological Opinion, dated February 13, 1990, concluded that the Basic Raindriven Plan for the MWD Project would result in jeopardy. The Biological Opinion led to more intensive and extensive studies on the ecology of the snail kite in Florida, and the resulting scientific findings have significantly altered the assumptions of the 1990 Biological Opinion, which represented the best available science at that time.

On September 19, 1996, the Service issued a Biological Opinion on the Corps' permit application from the Florida Department of Transportation to construct three recreational access points along Interstate 75 in Broward County, which runs east-west through WCA-3A. The Biological Opinion addressed adverse effects on the snail kite, wood stork, and the Florida panther. For the snail kite, mortality of adult birds was not anticipated, but we anticipated potential additional disturbance of nests, with some loss of eggs or nestlings, primarily due to increased air boat traffic (although the area was already open to airboat use). To reduce the incidental take of all three listed species, terms and conditions listing improved signage and educational materials for potential users about the presence and sensitivity of these species and improved mapping of established trails were provided.

The Service formally consulted with the Corps regarding the Water Management Plan for the Blue Cypress Water Management Area, Upper St. Johns River Basin Project. A portion of that Water Management Area located in western Indian River County is designated as critical habitat for the snail kite. The local sponsor for the project is the St. Johns River Water Management District. Our Biological Opinion, dated November 14, 1996, provided a number of terms and conditions to reduce incidental take, including close monitoring of snail kite activity and habitat usage, vegetation changes, water levels, and water quality.

The Service issued a Biological Opinion, dated July 3, 2002, on the Corps' issuance of a permit to FWC to draw down water levels and scrape accumulated organic sediments in the KCOL (Lakes Tohopekaliga, Kissimmee, Cypress, Hatchineha, and Tiger). The Biological Opinion analyzed potential effects on the snail kite for a habitat management action that, in the long term, has proven to be beneficial to the species, but required granting incidental take for short-term adverse effects. This Biological Opinion referred back to previous projects of a similar nature that the Service reviewed, including Biological Opinions on lake habitat enhancement projects: (1) Lake Tohopekaliga (1971, 1979, and 1987); (2) Lake Kissimmee (1977 and 1996); and (3) East Lake Tohopekaliga (1990). As with these previous consultations, we provided terms and conditions to reduce incidental take, and FWC funded a number of studies to test the effects of the management actions (drawdown alone and drawdown with muck removal) on snail kites, apple snails, and vegetation. Through these studies and subsequent observations, we are confident that such projects can have long-term beneficial effects on snail kite habitat, if they are not conducted too frequently. We have recommended that such actions be rotated among the lakes comprising the KCOL to allow sufficient time between the short-term adverse effects in a single lake.

The Service consulted formally with ENP on their 2003 to 2005 Prescribed Burn Plan. We recognized that periodic fire was necessary to sustain habitat conditions for a variety of wildlife (long-term effects), including the snail kite, but needed to estimate short-term incidental take for the snail kite. The April 1, 2003, Biological Opinion concluded that adult snail kites were not likely to be injured or killed because of the actions, but prescribed fire may result in direct impacts to kite foraging, nesting habitat, and kite nests. We believed that there would be no mortality of flighted birds, but up to 40 individual kites would be harassed. In a similar analysis of the 2003 to 2004 Burn Plans on the Loxahatchee NWR (June 10, 2003), we estimated that only two birds per year would likely be harassed as a result of the proposed action.

On October 23, 2003, we provided an intra-Service section 7 consultation on the issuance of a recovery permit to Dr. Wiley Kitchens of the University of Florida, and students working under him, to continue research on the species. During the course of their research, they handle many nestling snail kites to band them. We estimated that capture, handling, and banding might result in the accidental injury or death of 1 percent of the snail kites captured. Based on the expectation that up to 300 chicks may be captured per year, up to 3 individual chicks may be injured or killed per year.

For the Kissimmee River Restoration Project, we concluded (on June 14, 2005 and on March 5, 2007) that the proposed restoration would be beneficial to the snail kite and, therefore, did not issue a biological opinion.

On May 18, 2007, the Service issued a Biological Opinion to the Corps on a temporary deviation to the normal regulation schedule for Lake Istokpoga requested by the District in response to severe drought. At the time of the consultation, three snail kite nests were active on the lake, for which we had to grant incidental take. On December 21, 2007, the Service issued another Biological Opinion, on the District's request to extend the temporary deviation from October 2007 to October 2008.

On April 17, 2009, the Service concurred with the Corps determination that the L-30 Seepage Management Pilot Project would not adversely affect the snail kite.

The Service issued a Biological Opinion, dated August 25, 2009, on the C-111 Spreader Canal Western Phase 1 Project, concluding that while the proposed action would "adversely affect" CSSS, the project would have "no effect" on the snail kite or its designated critical habitat.

The Service completed formal consultation on the snail kite for one of the projects identified as part of the District's Acceler8 program – Compartment B STA expansion (Service 2009f). While the early plan for this project focused on discharges of total phosphorus into the greater Everglades into snail kite critical habitat that with concentrations higher than that required to meet the phosphorus criterion, the final plans for this project involved a relocation of the projects discharge such that unimpacted wetlands were not anticipated to receive direct discharges from this project. Additionally, we have formally consulted regarding effects of Acceler8 projects on other species, particularly the threatened eastern indigo snake and Audubon's crested caracara (*Polyborus plancus audubonii*). The C-44 and C-43 projects will be located on former citrus groves, which are generally of low or negligible value as habitat for the snail kite. Likewise, the site of the EAA Reservoir Project had been sugarcane fields and some sod farms, neither of which are considered particularly valuable as snail kite habitat. The site of the Picayune Strand Restoration Project, and the other Acceler8 projects were not likely to adversely affect the snail kite. We have recently re-initiated informal consultation with the District on the C-44 Project to ensure that copper contamination will not adversely affect snail kites through the food chain. We are working with the District to ensure that they include monitoring of copper concentrations in apple snails to verify that potential foraging by snail kites in the STA of the C-44 Project will not pose a risk to the snail kite.

Appendix B – Future Actions Proposed by the Corps

Appendix B
Future Actions Proposed by the Corps

In the July 2015 Supplemental ERTP-2016 BA, the Corps proposed undertaking four additional measures under Corps' authority that they believe may act to further protect CSSS in the future. However, these actions are not included in the analysis of the proposed action for this Biological Opinion. Several of these measures are dependent upon results of ongoing and future testing or construction of features, and therefore, are proposed to be included in future consultations. The Corps stated in the July 2015 biological assessment that they are committed to implementing these measures; therefore, water management operations are expected to evolve over the next several years to include the following additional actions: 1) a Water Flow Analysis Test; 2) MWD Project Increment 1 Field Test; 3) MWD Increment 2 Field Test; and 4) Combined Operational Plan (i.e. MWD Increment 3 [COP]). In addition, the Corps, in coordination with an interagency team, is proposing to prepare an assessment of potential effects of L-28 Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, the Corps has not yet determined what authority might be required for such action. The MWD Project Increment 1 Field Test, which began in October 2015, includes relaxation of G-3273 which was a Term and Condition of the November 17, 2010, ERTP BO. As part of the MWD Project Increment 1 Field Test, the Corps is required to conduct a spreadsheet tracking analysis to quantify how revised operations under the MWD Increment 1 Field Test would affect flows through the S-12A, S-12B, S-343A, S-343B, and S-344 structures. Additional detailed discussion of these future actions is provided below.

1.1 Water Flow Analysis Test

Potential effects of western flows from eastern Big Cypress National Preserve (BCNP), west of WCA-3A L-28 Levee on CSSS-A were analyzed by the Corps during CSOP coordination with the Service in 2006-2007, including presentations to the 2007 Avian Ecology Workshop. Additionally, the 2010 ERTP Biological Opinion pointed to the possibility of flows caused by increased stages within WCA-3A potentially causing deeper water along the western side of CSSS-A. In that BO, it was noted that ENP has hypothesized that higher stages in WCA-3A since the early 1990's has reduced the amount of easterly flow through Mullet Slough directing it south along the west side of the L-28 Levee to the Tamiami Trail section between the Forty and Fifty-mile bend. Water from this area travels south along the western side of subpopulation A and may be responsible for deeper water depths and prolonged hydroperiods that have caused vegetation shifts in the area. It was expected that the western water flows could be reduced with the lowering of WCA-3A stages as a result of ERTP and other previously proposed actions (Service 2010). However, reduced western flows have not yet been realized.

In order to gather additional data on the western flows, the Corps proposed in the July 2015 biological assessment to implement a Water Flow Analysis Test to identify potential sources of water entering western Shark River Slough. The objective of the test is to characterize how surface water moves within the western ENP watershed (south of Tamiami Trail), including the effects on flow distribution from adjacent borrow canals and bridges along Tamiami Trail and Loop Road, L-28 Canal, WCA-3A outlet water control structures and WCA-3A seepage in order to: 1) identify preferential flow paths, with primary focus on flow paths affecting CSSS-A core habitat areas; 2) estimate flow velocity (e.g. travel time); and 3) evaluate effects from WCA-3A discharges. The results of the analysis could be used to formulate measures to address water flow into CSSS-A habitat. This effort will require NEPA documentation as well as subsequent consultation under the ESA and all other applicable environmental laws and regulations. It is important to note that the Corps has not identified authority to implement any measures which may be developed as a result of the test.

The Corps established an interagency team to include Federal and State agencies as well as members of the Miccosukee Tribe, to review the preliminary goals and objectives and define a scope of work to complete the water flow analysis. The initial proposal was that the test should be performed under two hydrologic flow regimes: 1) early in the wet season prior to July 15th, when the S-12A, S-12B, S-343A, S-343B and S-344 structures are closed; and 2) at the peak of the wet season when all structures are open, prior to November 1st. The results from the first test may be used to identify areas for more refined and intensive monitoring. The earliest that this test could take place is during 2016, if conditions are appropriate.

Subsequent discussions with ENP and FWS has indicated that the FWS/ENP position is that there is sufficient information currently available and that a flow test is not needed to further investigate the western flows. Based on these discussions, the Corps is no longer pursuing completion of the tracer test. The Corps shall work with the FWS, ENP and BCNP to provide an analysis of the potential effects of Western Flows (i.e., the effect of infrastructure and operation of the L-28 canal, L-28 Tieback, the S-343A, S-343B, S-344, Tamiami Canal, Loop Road, and all associated bridges and culverts), including the S-344 and L-28 plugs, on CSSS-A, and if necessary a seepage study analysis to include the southwest corner of WCA-3A will be conducted. Additional discussion of related future actions regarding western flows is provided within Section 1.5 of this Appendix.

1.2 MWD Project Increment 1 Field Test

The MWD Project Increment 1 Field Test, a deviation to ERTP, includes relaxation of G-3273, a term and condition of the November 17, 2010, ERTP Biological Opinion. As part of the MWD Project Increment 1 Field Test, the Corps will conduct a spreadsheet tracking analysis to quantify how revised operations under the Increment 1 Field Test could reduce flows through the S-12A, S-12B, S-343A, S-343B, and S-344 structures. The Corps proposes that water management operations for approximately two years be governed by MWD Project Increment 1 Field Test. The MWD Increment 1 Field Test was initiated on October 16, 2015, when hydrologic conditions allowed for relaxation of G-3273 above 6.8 feet NGVD consistent with MWD Increment 1 Field Test objectives.

The objectives of the MWD Increment 1 Field Test are defined as:

1. Improve hydrological conditions in NESRS through the relaxation of G-3273 stage criteria to increase water deliveries from WCA-3A to NESRS, while maintaining other C&SF Project authorized purposes.

2. Use S-356 pump station to manage seepage from NESRS to L-31N Canal resulting from the relaxation of G-3273 stage constraint on S-333, in conjunction with increased flows through S-333 spillway to NESRS via L-29 Canal.
3. Improve hydrological conditions in NESRS by maximizing the flexibility and efficiency of the existing infrastructure, including use of seepage management (e.g., S-356) to complement inflows to NESRS from WCA-3A.
4. Gather and analyze infrastructure performance, ecologic, hydrologic and water quality data sufficient to support MWD Project Increment 2, resulting in the following:
    a. Data gathering sufficient to support water quality certification
    b. Refined operational criteria for the MWD and C-111 South Dade Projects
    c. Updates to the 2012 Water Control Plan (i.e., ERTP)

Information obtained from the Increment 1 Field Test is planned to be codified within the revision to the 2012 WCAs-ENP Water Control Plan (Corps 2012). In addition, information obtained through Increment 1 will be used to support development of a second field test (MWD Increment 2 Field Test) and subsequent consideration of future incremental modifications to the 2012 WCAs-ENP-SDCS Water Control Plan (Corps 2012c) to include COP (MWD Increment 3). Further information pertaining to the MWD Increment 1 Field Test can be found in the June 2015, G-3273 Constraint Relaxation/S-356 Field Test and S-357N Operational Strategy Environmental Assessment and Finding of No Significant Impact (FONSI) (i.e. MWD Increment 1 Field Test; Appendix C). Increment 1 was coordinated with the Service and a multi-agency team, consisting of Federal and State agencies, federally recognized Tribes and the public between May 2014 and June 2015.

Throughout the MWD Increment 1 Field Test, the Corps will employ a spreadsheet tracker to better understand the potential reduction in use of the S-12A and S-12B structures as a result of increased usage of S-333 due to relaxation of G-3273 stage constraint. Observed S-12 discharges during the MWD Increment 1 Field Test will be manually adjusted to estimate the S-12 discharges if operations remained under the 2012 Water Control Plan. Increased discharges from WCA-3A to NESRS via S-333 that are observed due to relaxation of G-3273 stage constraint will result in reduced WCA-3A discharges through the S-12s. Reduced discharges from WCA-3A to the C&SF SDCS, which will result from use of the S-356 pump station to manage seepage from NESRS to the L-31N Canal and additional restrictions regarding available capacity within the SDCS during this mode of operations, may offset a portion of the reduction in WCA-3A discharges through the S-12s. The operational condition when regulatory releases from WCA-3A are made via S-333 and S-334 to the L-31N Canal and the SDCS, generally with concurrent use of pumping stations S-331, S-332B, S-332C, and S-332D, is referred to as Column 2 operations under IOP and ERTP. This test and the associated spreadsheet tracker were previously coordinated with the Service and concurrence was received from the Service in a letter dated February 10, 2015.

1.3 MWD Increment 2 Field Test

The MWD Increment 2 Field Test will be the second field test to transition the environment within the ERTP-2016 Action Area. Information and operational criteria identified in the MWD

Increment 1 Field Test will be used to develop an expanded set of operations and monitoring criteria for MWD Increment 2 Field Test that will raise the maximum operating limit in the L-29 Borrow Canal level above 7.5 feet NGVD, up to a maximum of 8.5 feet NGVD, as outlined in the 1992 MWD GDM and FEIS (Corps 1992). Operational changes based on MWD Increment 1 Field Test are planned to be incorporated into the 2012 WCAs-ENP-SDCS Water Control Plan (Corps 2012) prior to implementing the operational strategy for MWD Increment 2 Field Test as appropriate. Additionally, the Corps will work collaboratively with Federal and State partners to reassess S-332B, S-332C, and S-332D operations as part of the MWD Increment 2 Field Test. This will allow the prioritization in order of S-332B, S-332C, and S-332D pumping based on coordination with the Service, SFWMD, and ENP. Other operational changes to structures within the 2012 WCAs-ENP-SDCS Water Control Plan (Corps 2012) will be considered based upon input from a multiagency team. Hydrologic modeling is not planned to support development of operational criteria for MWD Increment 2 Field Test. Implementation of a multiagency team planning effort is currently scheduled to commence in April 2016. The Increment 2 Test is scheduled to begin in October 2017, and run for one year. This effort will require additional NEPA documentation as well as subsequent consultation under the Act and all other applicable environmental laws and regulations. As such, the Corps has not evaluated implementation of this test within their Supplemental Biological Assessment and therefore it will not be considered within the ERTP-2016 Biological Opinion.

1.4 Combined Operational Plan (i.e. MWD Increment 3)

The COP is the third and final increment in the development of an operational plan that incorporates constructed features of the MWD Project and C-111 South Dade Project into the WCAs-ENP-SDCS Water Control Plan (Corps 2012). MWD Increment 3, development of the COP, will be informed by the MWD Increment 1 and MWD Increment 2 Field Tests as well as hydrologic modeling. Operating plan scope and model tool development was scheduled to be initiated in September 2015, with implementation of a multiagency team planning effort scheduled to commence in July 2017, in order to include data obtained through MWD Increment 1 and Increment 2 Field Tests. This effort will require additional NEPA documentation as well as subsequent consultation under the Act and all other applicable environmental laws and regulations. As such, the Corps has not evaluated implementation of COP within their Supplemental Biological Assessment and therefore it will not be considered within the ERTP-2016 Biological Opinion. The Corps' current schedule proposes to have the approval for the Record of Decision for COP during the second quarter of fiscal year 2020, a seven year delay from the timeline proposed during the 2010 ERTP Biological Opinion.

1.5 L-28 Borrow Canal Analysis

During the July 2007 Avian Ecology Workshop, the Corps provided information that water table conditions in CSSS-A habitat fluctuated in unison with hydrologic gauging station BCA-9, located within BCNP demonstrating that a western source of water emanated from the L-28 Levee. The Corps had previously completed a Feasibility Study on the L-28 Borrow Canal in 1995. The Feasibility Study evaluated actions including infilling of open channel breaks, closure of the S-343A, S-343B, and S-344, and enhancing conveyance to the western portion of Loop Road, but these were never implemented.

ENP has hypothesized that higher stages in WCA-3A since the early 1990's have reduced the amount of easterly flow through Mullet Slough directing it south along the west side of the L-28 levee to the Tamiami Trail section between the Forty and Fifty Mile Bend. Water from this area travels south along the western side of CSSS-A and may be responsible for deeper water depths and prolonged hydroperiods that have caused vegetation shifts in the area. Due to regional topographic gradients, when WCA-3A is high, water from western WCA-3A flows south through gaps previously constructed in the L-28 Tieback Levee and a portion of the surface water drainage from eastern BCNP (Mullet Slough) flows south from areas west of the L-28 Tieback Levee. Under these conditions, the southerly flow is most likely funneled east of the Dade-Collier Training and Transition Airport (JetPort) towards the Forty Mile Bend area, with the L-28 Borrow Canal (located on the west side of the L-28 Levee) facilitating water conveyance south towards western ENP. Surface water flows moving south in this area of eastern BCNP, along with other BCNP basin runoff from areas to the immediate south of the JetPort, may be collected by the Tamiami Trail borrow canal (north side of road) and directed through Tamiami Trail bridges and Loop Road bridges into ENP near CSSS-A. Hydrograph responses at NP-205 demonstrate a high degree of correlation to upstream hydrographs at gauge BCNP A-9 during periods of S-12 closures. Vegetation mapping also indicates a transition from prairie-marsh to marsh vegetation along western CSSS-A and coincides with additional vegetation studies within CSSS habitat (Ross et al. 2003, 2004, 2006; Sah et al. 2007, 2008, 2009). Gaps in the L-28 Tieback were originally constructed in the early 1980s to restore overland flow and prevent over drainage of BCNP, with the gaps providing a means of regulatory discharges from WCA-3A to BCNP and concurrently reducing wet season peaks and dry season excess flows to ENP.

The L-28 Borrow Canal has been included as part of the Decompartmentalization project in CERP. The concern over the impact of L-28 on western flows was again brought up during the current consultation with the Service when it was suggested that the L-28 Borrow Canal may be a source of delivery of water flow into western CSSS-A. The Service and BCNP have prepared an initial analysis of the L-28 contribution which is included here as Appendix C.

Since evidence suggests that western flows have an adverse effect on CSSS-A, particularly within its western region, the Corps committed within the July biological assessment to prepare an assessment, using an interagency team, of potential effects of the L-28 Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action. Potential options under consideration, including partial or complete backfill of the borrow canal, are expected to provide benefits to CSSS-A as well as BCNP Actions proposed by this effort would require authorization, NEPA documentation, subsequent consultation under the Act, and all other applicable environmental laws and regulations. However, at the time of the BA development, the Corps had not yet determined what authority might be required for such further actions or a timetable for implementing the analysis. As such, the Corps did not evaluate implementation of L-28 Borrow Canal options within their Supplemental BA and it was not considered as a component of the proposed action for the ERTP-2016 Biological Opinion. The

Service feels that sufficient information is available from previous studies on the effects of L-28 on western flows to warrant inclusion as a possible Reasonable and Prudent Alternative (RPA) in this BO.

Through subsequent consultation concurrent with development of the BO and the RPAs, the Corps has committed to work with the FWS, ENP and BCNP to provide an analysis of the potential effects of Western Flows (i.e., the effect of infrastructure and operation of the L-28 canal, L-28 Tieback, the S-343A, S-343B, S-344, Tamiami Canal, Loop Road, and all associated bridges and culverts), including the S-344 and L-28 plugs, on CSSS-A, and if necessary a seepage study analysis to include the southwest corner of WCA-3A will be conducted. The Corps will continue to collect data from the 2016 S-344 emergency deviation and, in conjunction with the FWS, will analyze the data collected. This analysis will be considered in the Western Everglades Restoration Project which will be initiated in August 2016. The results of the analysis and previous studies shall be used as appropriate to formulate recommendations and implement projects (which could include full back-fill of L-28 and improved flows to Big Cypress National Preserve through S-344/S-343) that will reduce/eliminate detrimental effects to the CSSS and its habitat.

Appendix C – Western Water Flows Recommendations Benefiting the Cape Sable Seaside Sparrow Subpopulation A (CCSS-A)

Appendix C
Western Water Flows Recommendations Benefiting the Cape Sable Seaside Sparrow Subpopulation A (CCSS-A)

I. INTRODUCTION

Subpopulation A of the Cape Sable Seaside Sparrow (CSSS-A), located in the western marl prairie of Everglades National Park (ENP), collapsed in 1992-93 due to Hurricane Andrew. Despite significant multi-agency efforts over the past two decades to reverse the trend, CSSS-A has failed to recover. Multi-agency efforts have focused on the short-term solution of regulating inflows into the western marl prairie from the S-12 structures, along with flows from S-343A/B and S-344. Focus has also been on the long-term solution of moving more WCA-3A water eastward into Northeast Shark River slough instead of disproportionately keeping this water westward with discharges into the western marl prairie.

Recently, new science has identified an additional, largely-underappreciated and uncontrolled source of water: the so-called Western Water Flows. Its source emanates from the L-28 Levee along the western boundary of WCA-3A, and specifically the adjacent “Big Cypress side of the levee” canal.

The L-28 Levee and L-28 Interceptor levees were built in the mid-1960s as major works of the Central and South Florida (C&SF) Project. Their purpose were three fold: (1) to store water in WCA3, (2) to keep water on the Everglades side of the levee and off what was at the time private property (Big Cypress) on what is now the Big Cypress National Preserve (BCNP), and (3) drain Big Cypress water southward. Fifty years later the basic hydraulics of the L-28 levee and canal network remains in place. Water in BCNP is significantly diminished, while any excess of water undesirably drains south as described below.

- The L-28 Interceptor undesirably diverts BCNP bound water to the southeast into WCA3A. This has undesirably increased the depth and duration of high water and tree island flooding events in WCA-3A.

- The L-28 Levee undesirably drains water out of BCNP southward toward the western marl prairie in ENP.

- The dual effect of the L-28 Interceptor and L-28 Levee has been to decrease the operational effectiveness of discharging water from WCA-3A through the S-12s. The L-28 Interceptor increases water levels in WCA-3A, whereas the L-28 levee sustains a high water table in the S-12s tailwater even when those structures are closed, thus “keeping the pumps primed”.

II. HISTORY OF L-28 PERIMETER LEVEE

A. OVERVIEW

The L-28 Levee is a "works" of the Central and South Florida (C&SF) Project – built between 1950 and 1975. As part of that larger plan, the L-28 was conceptualized to run along the entire physiographic divide between the parochial Everglades and Big Cypress. That plan was cut short with discovery that Mullet Slough, a natural flow way in the Big Cypress, was discharging into the Everglades.

An 11-mile long abbreviated version of the L-28 Levee was built from 1960 to 1963, extending from Forty Mile Bend (near S-12A), the first two miles of which paralleled Tamiami Trail and then, for its final 9 miles, turns north along the apparent physiographic divide, but in actuality was built 4 miles to the east to avoid construction through cypress forest.

The area to the north was retained as natural wetland, and dubbed the L-28 Gap, for the purpose of allowing Mullet Slough to naturally drain, by gravity, into WCA-3A. (Big Cypress was in private ownership at the time, and as such, could not be flooded without compensation to owners. Further to the north, the L-28 Gap is bounded by two levee-lined canals: the L-28 Borrow (North) and the L-28 Interceptor.

Shortly after its construction, it was discovered that Mullet Slough was missing entry into the L-28 Gap and into WCA-3 as planned, but instead was flowing down the Big Cypress side of the levee. That short coming necessitated a 1965 4-mile extension of the L-28 Levee to the north. Of note, the borrow canal "switches sides" to the WCA3 side of the levee for the 4-mile extension, and the northernmost 2 miles were oriented (or bent) to the west, and thus dubbed the L-28 Tieback.

Its name as a "tieback levee" is somewhat of a misnomer because it does not officially "tie back" to an upstream levee. But its design intent, to steer Mullet Slough flows into WCA-3 by extending the levee westward until it intersected the 10.5 ft. (NGVD 1929) topographic contour line within the pinelands of the Big Cypress, matches its nomenclature in spirit. The levee never made it that far, but was instead stopped at the approximate 9 ft. contour line at the Dade/Collier County line.

Importantly, plans also existed to extend the L-28 Levee (and canal) south and then west along the present day boundary between ENP and BCNP. Although never built, this extension underscores the overarching intent of the L-28 network to get rid of water (out of the BCNP) by sending it south and quickly to the coast.

B. HISTORY OF L-28 LEVEE

The present-day version of the L-28 Levee was finalized in 1983, largely in response to the high-water El Nino event of 1983. A series of earthen canal plugs, open-channel levee breaks, and gated culverts were added in order to "restore overland flow south of the Tieback, prevent over drainage of the eastern portion of BCNP under dry conditions, and provide a means for making regulatory releases from WCA-3A as detailed below:

- Three wetland-grade breaks (to an elevation of 10 ft.), each at a width of about 150 ft., were cut through the L-28 Tieback.

- Three gates, S-343A, S-343B, and S-344, were installed into the L-28 Levee. The S-343s are located along L-28s southern end where it parallels the Tamiami Trail. The S-344 is located 9 miles upstream at the terminus of the original levee, and where the canal switches sides across the levee. All three structures feed directly into the L-28 canal from WCA-3A.

- Six plugs, spaced at approximately one mile intervals and each 150 ft. Long, were added to the L-28 canal in the 9-mile reach between S-344 and the Tamiami Canal to counter (lessen) drainage effects of the canal, especially during the dry season.

- The Corps completed a feasibility study on the L28 in 1995. Recommendations included: (1) filling of open-channel breaks in the L-28 Tieback (2) closure of S-343s and S-344, and (3) enhancing conveyance of water to the western portion of Loop Road at Sweetwater Strand, but were never implemented.

- Despite substantial management regimes for controlling for flow through the S-12s over the past two decades, higher than anticipated water levels continue to persist in WCA-3A. There is growing scientific consensus that strategic modification of the L-28 can help correct the problem.

C. HISTORY OF L-28 INTERCEPTOR

The L-28I drainage system was constructed in the mid-1960s for the primary purpose of providing flood relief to the Seminole Reservation. Lands north and west of the reservation also receive a degree of flood relief from the canals as described below:

- Its three main canals, the L-28I, North Feeder, and West Feeder, are deep (10-20 ft.) and wide (100-200 ft.) and are banked on both sides with earthen levees that stand 5-20 ft. above natural land surface. Under current conditions, flow rates in these canals are completely dictated by the force of gravity and the setting of the gates on the S-190.

- The drainage system does not feature either back-pumping or pump-induced drainage, which are common features in other parts of the C&SF drainage system. There are two reasons for this. First, neither the North or West Feeders are connected to upstream canal networks, such as the EAA< therefore neither is subject to peak flood flows routed down from the Kissimmee / Lake Okeechobee drainage system. Second, there exists a 6-ft vertical head difference between the headwaters and tailwaters of the L-28I. This difference provided a sufficient amount of natural energy for gravity to handle the drainage load by itself, without pumping.

- Other motivations also played a part in extending the L-28I. Its long length allowed floodwaters to be dumped directly into WCA3A. Lining the canal with levees also allowed floodwaters to bypass the lands of the Big Cypress. A seven mile stretch of the L-28I north of I75 was shifted a mile to the northeast during its construction in order to bypass California Slough (Figure 1).

- The S-190 spill gate officially marks the upstream end of the L-28I. The S-190 is a gravity-fed flow structure located a half mile south of where the North and West Feeder Canals converge. Its flow is controlled by a pre-defined wet season (14.2-14.8 ft. above sea level) and dry season (15.2-15.8 ft. above sea level) operating schedule. Generally speaking, the gate settings are designed to provide flood relief during the wet season and drought protection during the dry season.

- The operational rules of the S-190 are under review for the purpose of maintaining dry season stage at a higher level.

In summary, L-28 Levee and L-28 Interceptor are 1960 era drainage infrastructure that is out of tune with the conservation values of the protected Big Cypress/Everglades ecosystem it bisects (Figure 2). The +35 miles of levee and canal continues to do what it was designed to do: divert and remove water from modern-day BCNP and counterproductively drain it to the south. While this outcome originally made sense when the drainage infrastructure was built (i.e. protection of private property on the Big Cypress side of the levees), it no longer makes sense for a preserve, and as important, it also causes a detriment to the areas that receive this diverted water: WCA-3A (i.e. high water flooding) and downstream marl prairie (i.e. spring flooding of CSSS-A habitat).

III. RECOMMENDATIONS

The following short and long-term recommendations will benefit CSSS-A and its habitat and have a wide range of positive hydro-ecological benefits to the Everglades and Big Cypress Swamp.

A. Short-Term Action

Fill approximately southern eight (8) miles of the north-south oriented section of the L-28 canal to wetland grade using fill from the Old Tamiami Trail roadbed (i.e. the 7 miles slated for removal).

Benefits of this proposed action include the following:

- Sever Western Water Flows at its source.
- Decrease water levels in the western marl prairie thus benefiting CSSS-A.
- Be aligned with the overarching goal of BCNP to return as close as possible to a rain-driven watershed that is impacted as little as possible by drainage infrastructure.

- Open the possibility for the first time ever of being able use the S-344 as a relief value for sending water from WCA-3A into the BCNP ecosystem, instead of down the L-28 No additional water would be diverted or retained in WCA3A
- The source of fill is close by and currently slated for removal. It is a great ecological use of the fill that would otherwise be more expensive to haul away. Thus making this cost effective.
- Avoids complication with other aspects of water delivery with ongoing Everglades Restoration projects (i.e. new bridges, and relaxation of G-3273 constraint).
- Anticipated to enhance deliveries from WCA-3A through the S-12s since the previously uncontrolled Western Water Flows will be out of the equation.
- Would mitigate against drought in BCNP, thus reducing the impact of costly and ecosystem-damaging wildfires.

B. Long-Term Action

Modifying the L-28 Interceptor/West Feeder canals to hold back and reintroduce a portion of this water into BCNP as opposed to having all discharge into WCA3A. This would provide flood relief benefits to WCA-3A during times of high water. This action would benefit BCNP by restoring a portion of its upstream overland flows that have been severed as a result of the L-28 levee.

Benefits of this proposed action include the following:

- Return BCNP intended water to the preserve
- Would reduce point-charge inflows into WCA-3A
- The proposed actions are in concert with the overarching goal of BCNP to return as close as possible to a rain-driven watershed that is impacted as little as possible by drainage infrastructure.
- Anticipated to enhance deliveries from WCA-3A through the S-12s since the previously uncontrolled Western Water Flows will be out of the equation.

IV. CONCLUSION

Western Water Flows are driven by the hydraulics of the L-28 Levee and L-28 Interceptor infrastructure (i.e. levees, canals, and structures). This infrastructure has never been substantially changed since it was installed in the 1960s, the result of which has been over-drainage of water around and away from BCNP in favor of channeling of the surplus water south (into WCA3A and the western marl prairie). In particular, the CSSS-A has been negatively affected as a result.

Absent the proposed changes to the L-28 Levee and L-28 Interceptor, Western Water Flows will continue to pose hydro-ecological impairment to the western marl prairie and CSSS-A despite rigorous control of the S-12s, S-343s, and S-344.

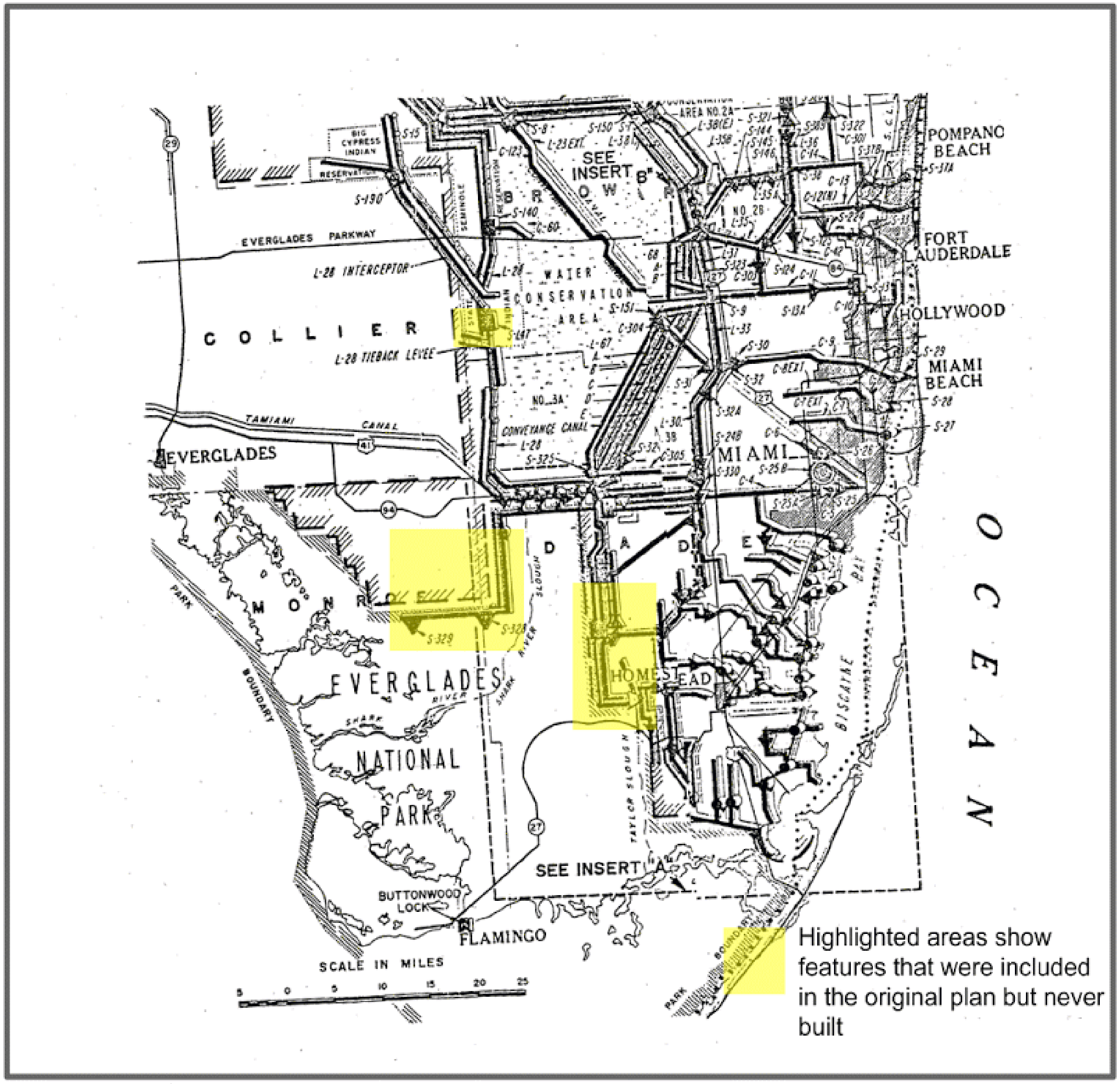


Figure 1: Map showing plans for the L-28 Levee and L-28 Interceptor as originally planned

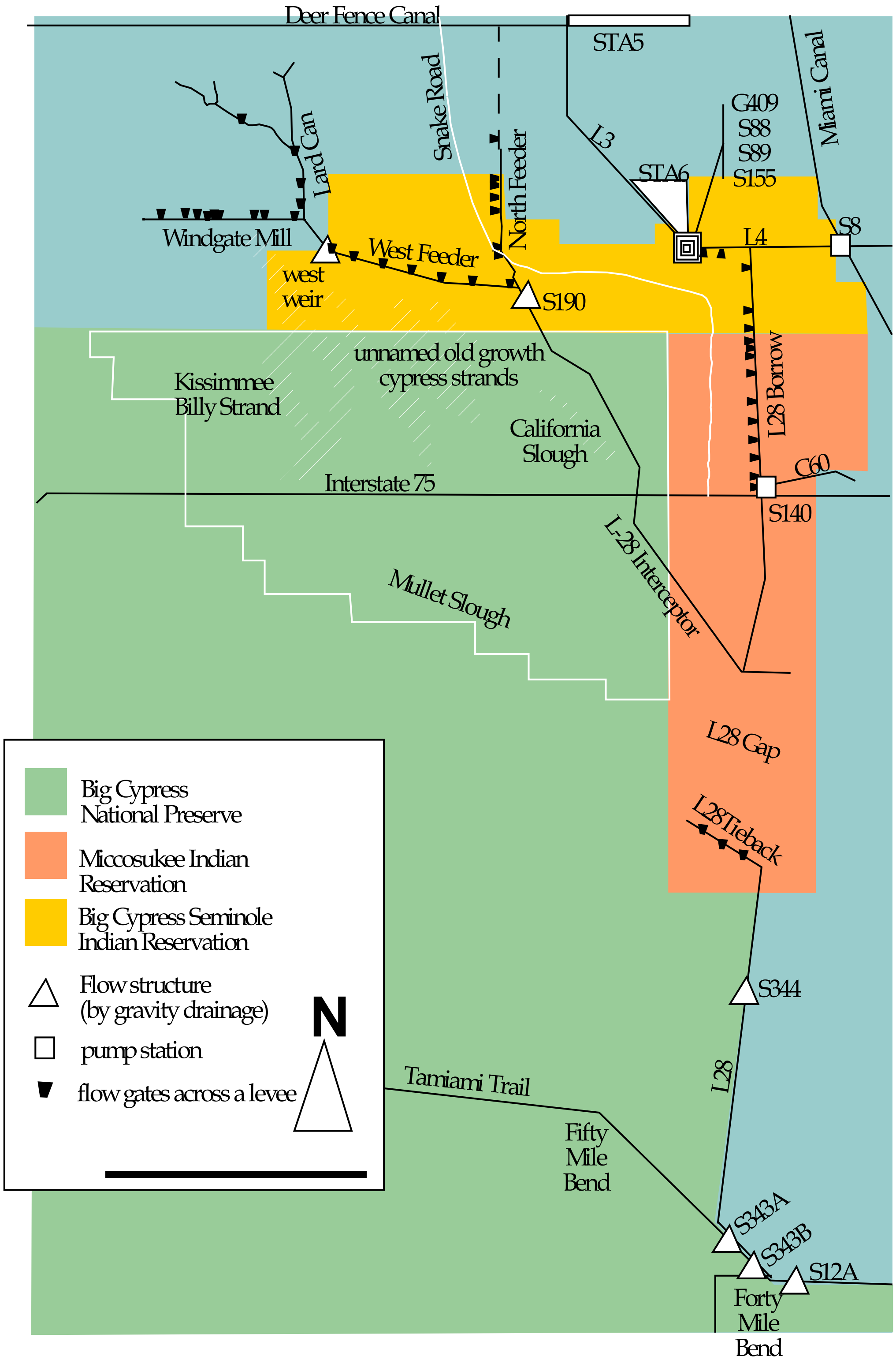


Figure 2: Overview Map of L-28 Levee and L-28 Interceptor

Appendix D – Climate and Climate Change Analysis

APPENDIX D
Climate and Climate Change Analysis

Climate of South Florida

The climate of south Florida is driven by a combination of local, regional, and global events, regimes and oscillations.

Local Events

Locally, periodic surges of cool and dry continental air masses influence the weather during the dry season (November – May) with short duration rain events, usually light rain or rain showers, followed by long periods of dry weather. The Atlantic and Caribbean tropical and sub-tropical air masses dominate Florida during the wet season (June – October) with the majority of rainfall coming from the land and sea breeze thunderstorms. These storms are capable of heavy downpours with torrential rains, gusty winds, and dangerous cloud to ground lightning. The months of October and May are transition months between the dry season and wet season and are marked with variable rainfall patterns (Figure 1). Another significant source of heavy rainfall during the wet season is from tropical weather systems such as tropical waves, tropical depressions, tropical storms, and hurricanes.

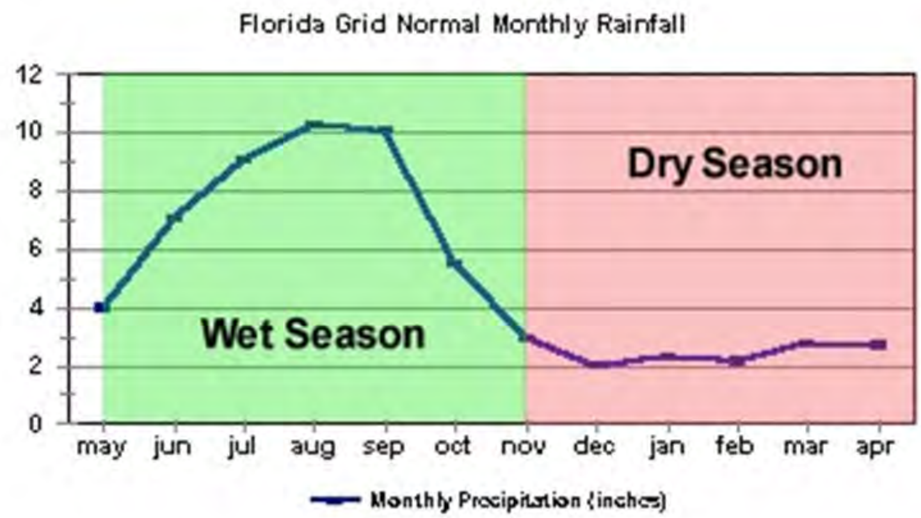


Figure 1: Annual Rainfall distribution. (NOAA 2015).

The El Nino Southern Oscillation (ENSO)

ENSO occurs every 2 to 7 years (with an average of 4 years) in three phases – El Nino, ENSO-Neutral, or La Nina. The various phases of ENSO are due to periodic changes of sea surface temperatures (SSTs) in the equatorial Pacific Ocean (Figure 2 and 3).

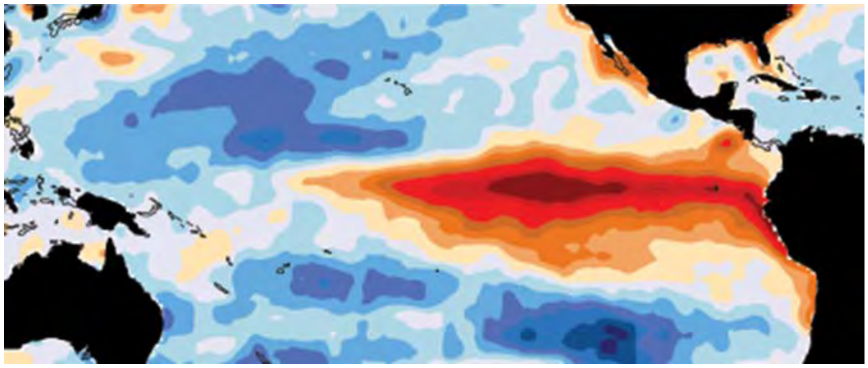


Figure 2: During an El Nino, ocean temperatures warm in the tropical Pacific Ocean (NOAA Climate Prediction Center, 2015).

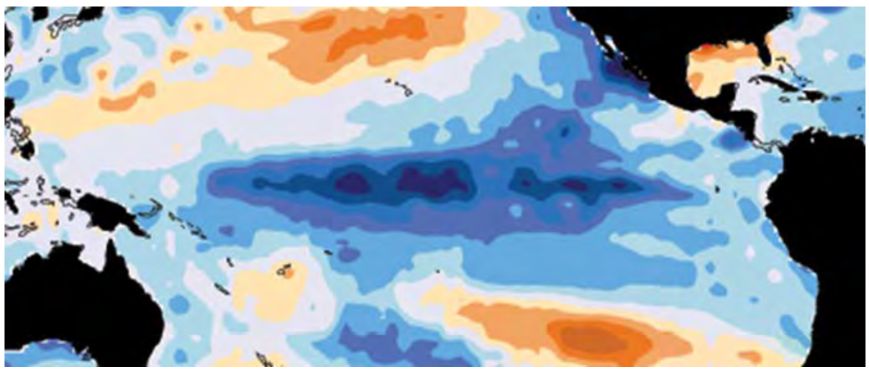


Figure 3: During La Nina, ocean temperatures cool in the tropical Pacific Ocean (NOAA Climate Prediction Center, 2015).

Once the SSTs are either warmer or cooler than average, they influence the trade winds, atmospheric pressures, cloudiness and storm tracks in the Pacific Ocean. These weather conditions then also affect jet streams and weather patterns in Florida. During an El Nino event, the sub-tropical jet stream is located farther south and brings Pacific and Gulf of Mexico moisture eastward into Florida (Figure 4). This typically creates a wetter than average wet season. La Nina (Figure 4) is just the opposite weather wise for Florida causing a drier than average dry season. ENSO-Neutral is usually responsible for an average dry season. There have not been any correlations as of yet between the ENSO and Florida's wet season. Below average or above average wet seasons seem to be more dependent on tropical storms or the lack of them.

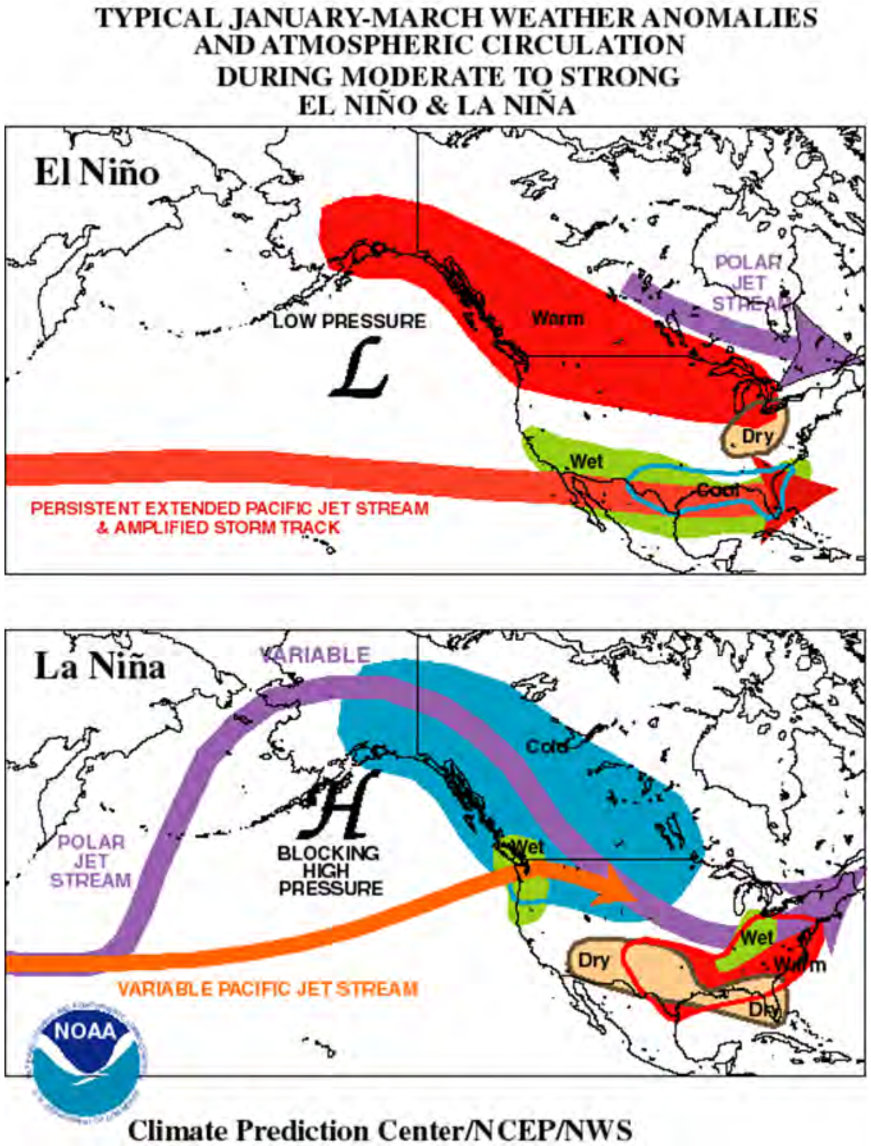


Figure 4: Expected weather patterns due to El Nino and La Nina (NOAA Climate Prediction Center, 2015).

An analysis was performed using a gauge in ENP (NP-205) regarding annual rainfall in relation to El Nino, ENSO-neutral, and La Nina events (Figure 5).

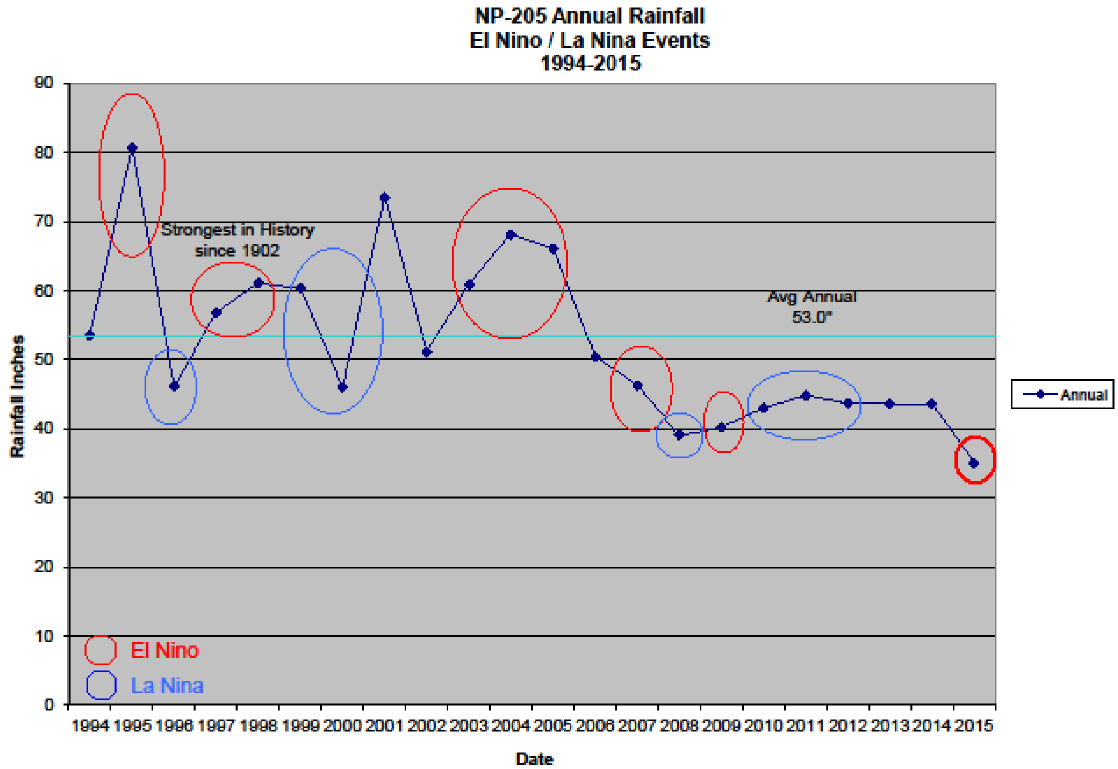


Figure 5: Annual rainfall and frequency of El Nino and La Nina events at gauge NP-205 from 1994 into 2015. Events circled in red are El Nino events (warming of the tropical Pacific Ocean) and those circled in blue are La Nina events (cooling of the tropical Pacific Ocean). Significant weather events are also noted.

There is a strong correlation between El Nino events and a wet winter (dry season) for Florida. Tropical Storm Gordon (1994) and Tropical Storm Mitch (1998) were both late season (November) storms that moved across or affected NP-205 during El Nino years. Also during an El Nino event, there have been several early starts to the wet season or wet March and April. Much lower rainfall amounts during the dry season occurred during La Nina events Figure 6).

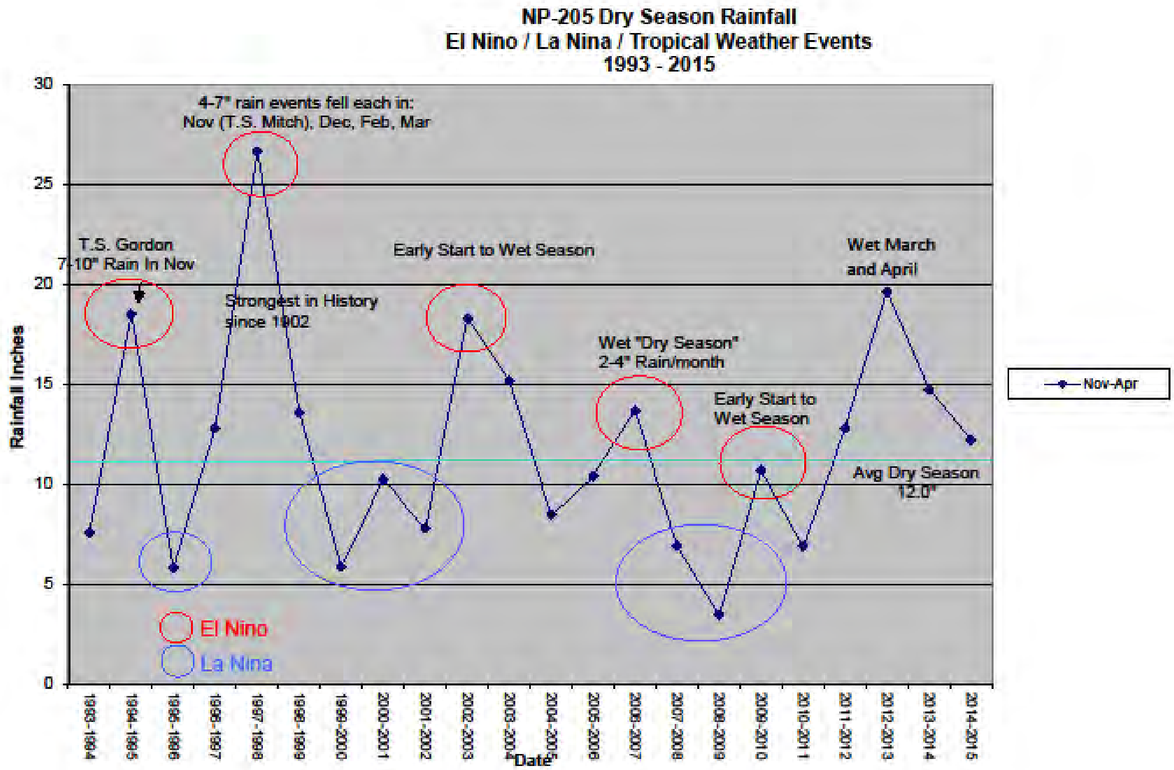


Figure 6: Dry Season rainfall and frequency of El Nino and La Nina events at gauge NP-205 from 1994 into 2015.

Although there is a strong correlation between El Nino and a wet dry season in Florida, a strong correlation of rainfall during El Nino in the upcoming wet season has not been determined throughout the historical records. However, statistically there is a higher frequency of dry wet seasons following El Nino. Figure 7 shows the summers that tropical weather affected NP-205 along with dates and the amount of rainfall received. Not only does it appear that rainfall amounts have been decreasing at NP-205 since 2006, but the area has not been affected by a large rainfall producing tropical storm or hurricane since 2006.

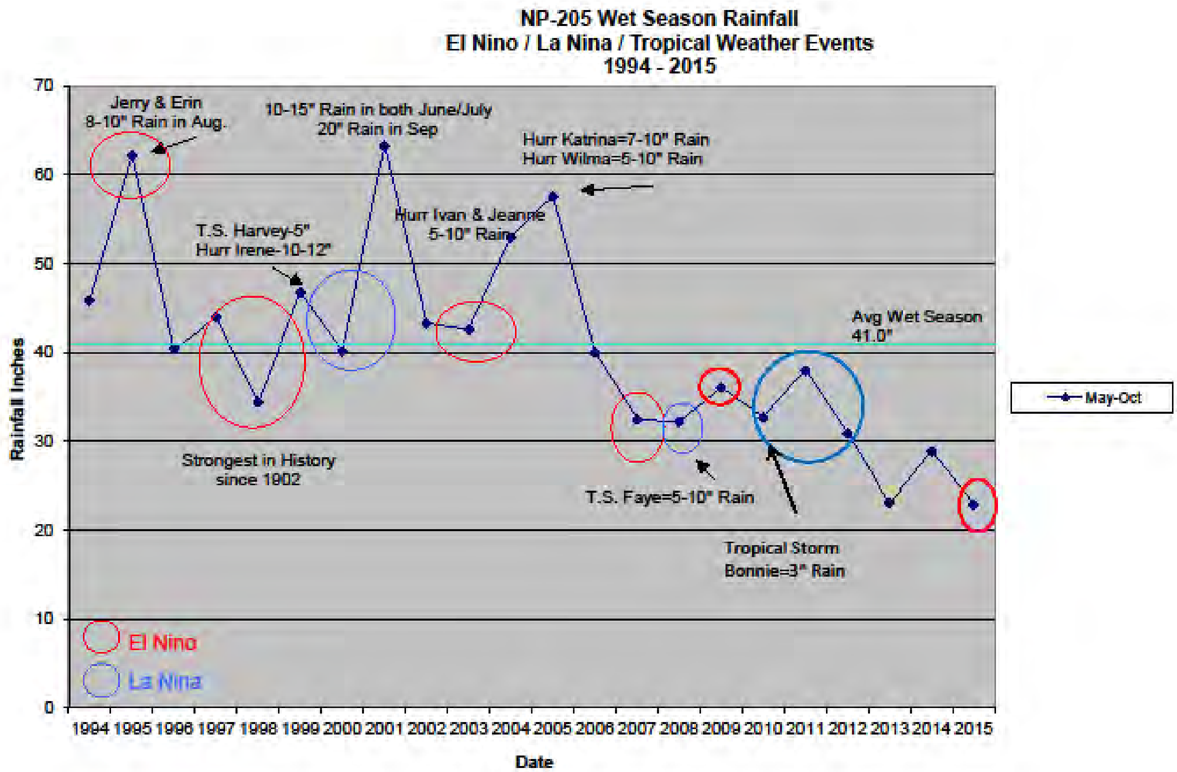


Figure 7: Annual rainfall and frequency of El Nino and La Nina events at gauge NP-205 during the wet season from 1994 into 2015.

The following are weather and hydrologic conditions likely for Florida during each of these events:

El Nino:

- Wetter than normal dry season
- Decreased Atlantic Ocean hurricanes
- Above average surface water elevations
- Fewer fires with smaller burn areas

La Nina:

- Drier than normal dry season
- Cooler than expected winter
- Below average surface water levels
- More fires with large burn areas

ENSO-Neutral Phase:

- More deep freezes even if winter is not consistently as cool (the jet stream is free to meander north and south through the United States).

2015-2016 El Nino Status: **Very Strong El Nino**

The tropical Pacific Ocean and atmosphere reinforced each other, maintaining a very strong El Niño that persisted into early 2016. Tropical Pacific sea surface temperatures reached 4.5°F (2.5 °C) above average, exceeding El Niño thresholds by well over 3.6°F (2 °C), and at levels not seen since the 1997–98 event. El Niño peaked in December 2015.

The following ENSO indicators were consistently in El Nino ranges since the spring of 2015:

- ***Sea surface temperatures*** –Warmer than average **(El Nino)**
- ***Sub-surface temperatures*** (0-100m depth) – Very Much Warmer than average **(El Nino)**
- ***Southern Oscillation Index*** (measure of air pressure between Tahiti and Darwin, Australia) = Below normal. Normal ranges are +8 to -8. Sustained values below -8 indicate El Nino conditions. **(El Nino)**
- ***Trade Winds*** (equatorial Pacific Ocean) – Weaker than average. If trade winds are sustained lower than average, it indicates El Nino conditions. **(El Nino)**
- ***Cloudiness*** (at the equator near the Date Line) –Above average. **(El Nino)**

Outlook Following the El Nino 2015-2016:

Preceding an El Nino year, hurricane activity will be lower than average. During the El Nino event, which usually peaks in December or January, wetter than average conditions are expected in Florida during the winter (dry season). A strong or very strong El Nino does not mean that rainfall will be heavier than during a weak El Nino. It means that there is more certainty in the forecast of a wetter winter (dry season). There has not been a correlation established on the rainfall forecast for the following wet season. But statistically, the majority of wet seasons following an El Nino event have been drier than average.

The Atlantic Multi-decadal Oscillation (AMO)

The AMO is an ongoing series of long-duration changes in the sea surface temperature of the North Atlantic Ocean, with cool and warm phases that may last for 20-30 years at a time and a difference of about 1°F between extremes (NOAA AOML 2015). These changes are natural and have been occurring for at least the last 1,000 years. The AMO occurs in positive (warm) and negative (cool) phases. (Figure 8)

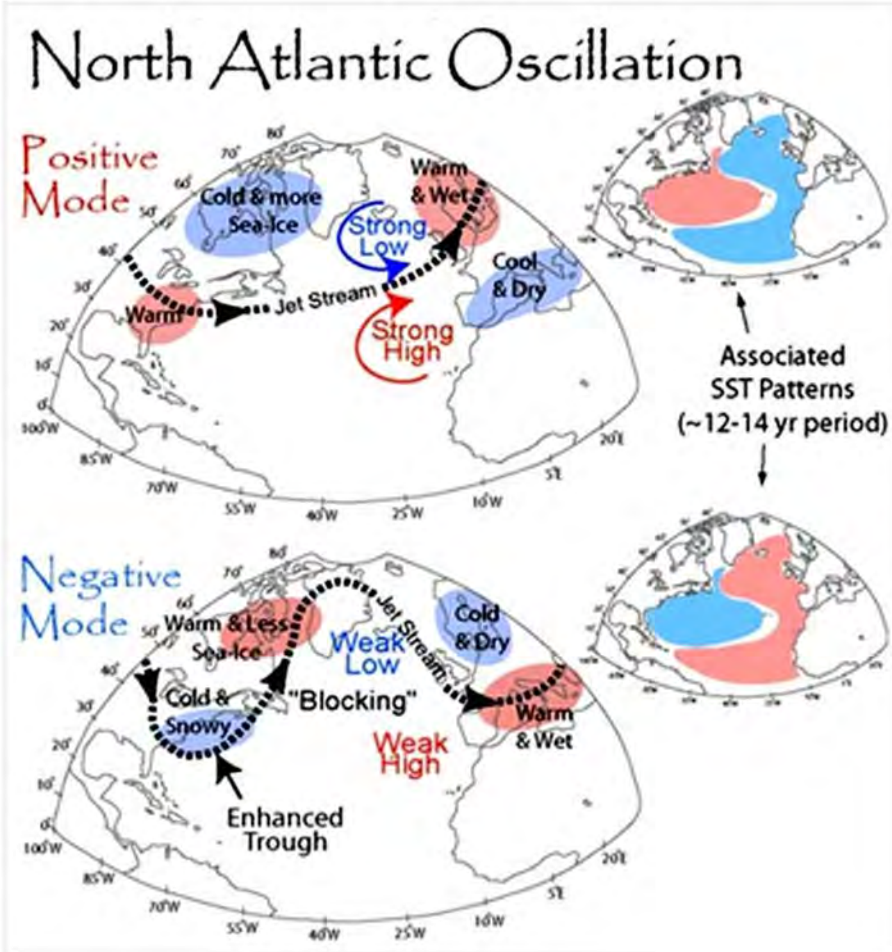


Figure 8: Positive (warm) phase and the negative (cool) phase of the AMO (Principia Scientific 2015).

Florida typically experiences wetter conditions during the warm phase as the Inter-tropical Convergence Zone (ITCZ) moves farther north, closer to Florida from the equator. The ITCZ is a global band of convective thunderstorms occurring 10 to 20 degrees north and south of the equator. During the cool phase of the AMO, Florida generally experiences less rainfall. Hurricane activity is elevated during the warm phase and is diminished during the cool phase (Figure 9). However, local weather and ENSO events can produce a wet or even dry weather year. Other than the local weather drivers and ENSO, the AMO highly influences Florida's extended wet and dry trends.

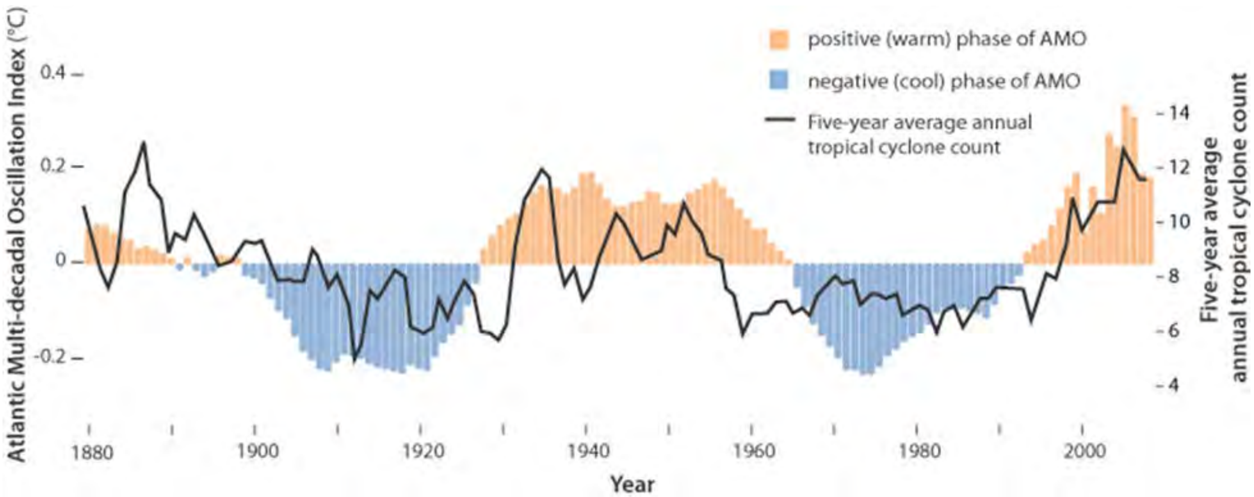


Figure 9: Hurricane frequency in both the warm phase and cool phase of the AMO (Climate.gov).

Historical and Current Conditions

Since 1900, there have been two cool phases and two warm phases of the AMO with each of these phases lasting approximately 20 to 40 years (**Table 1**). The exact year of the phase start and finish is an estimate as each phase goes through a "transition period" of a few years.

Table 1: Timing and duration of cool and warm AMO phases since 1900.

Years	AMO Phase
1906-1926 (20 years)	Cool phase
1927-1965 (38 years)	Warm phase
1966-1992 (26 years)	Cool phase
1993-present	Warm phase

Figure 10 illustrates the AMO cycles dating back to 1880.

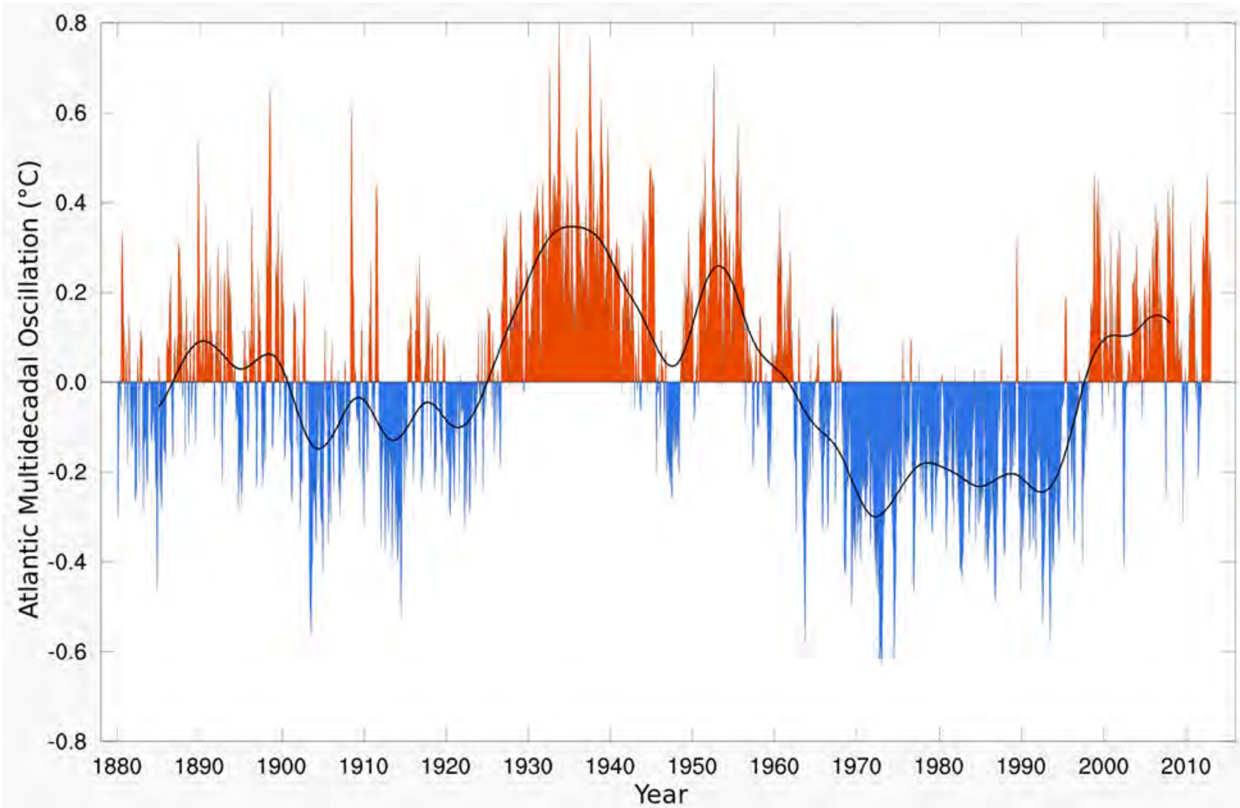


Figure 10: AMO periods where temperatures are above 0 degrees warmer are in a warm phase, and periods where temperatures are below 0 degrees cooler are in a cool phase (Climate.gov).

After analyzing rainfall data from 1965 to present at key indicator gauges throughout WCA-3A and ENP it is clear that the AMO went from a cool phase to a warm phase in the early 1990s. The peak of the warm phase of the AMO likely occurred from around 1992-2006. All gauges recorded many wet years during the peak. The analysis also indicates that the AMO warm phase has been weakening since 2006 with annual rainfall amounts and hurricane activity also diminishing throughout the Everglades system. (Figures 11 through 14)

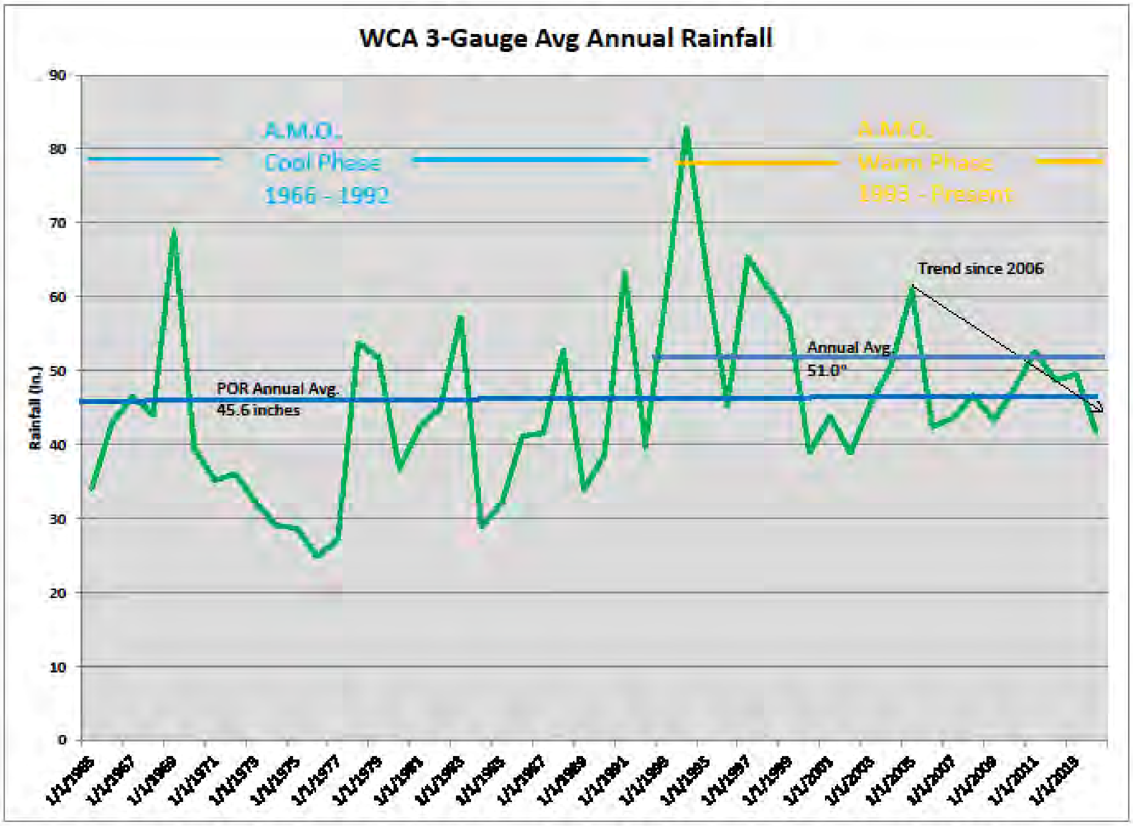


Figure 11: Annual rainfall totals for the 3-gauge average in WCA-3A (Site 63, Site 64 and Site 65) for a long period of record (POR) 1965 to 2014. The cool phase and warm phase of the AMO are indicated with a near-term trend of diminishing rainfall totals in the Everglades since 2006.

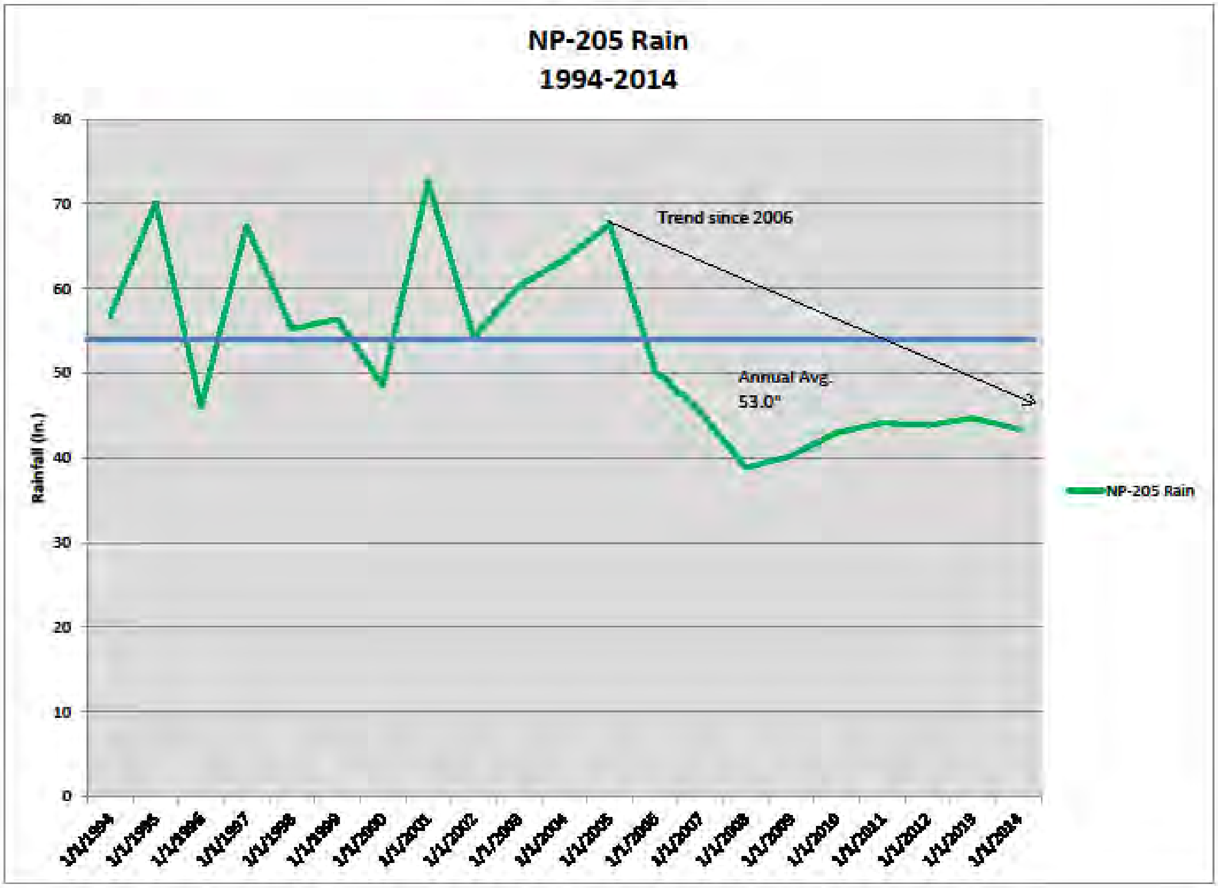


Figure 12: Annual rainfall totals at NP-205 in northwestern Everglades National Park within subpopulation A of the Cape Sable Seaside Sparrow. Rainfall trends have been decreasing since 2006 with many years of below average rainfall.

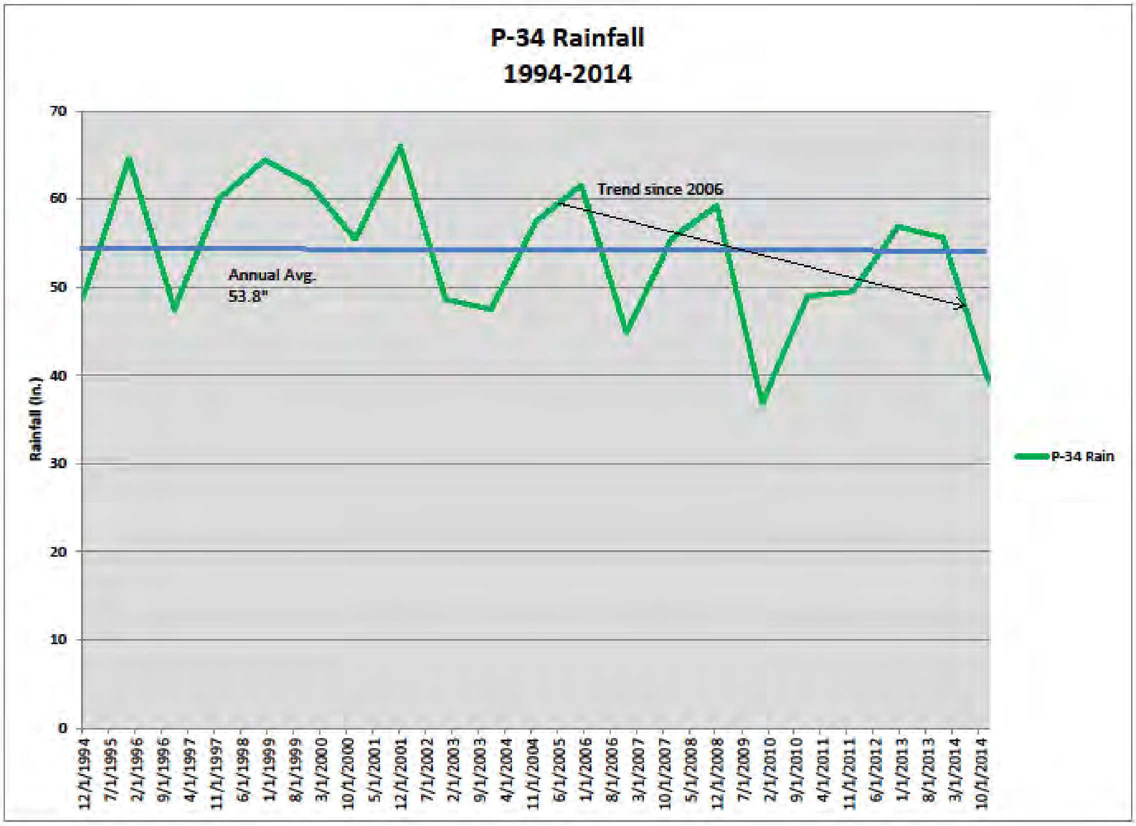


Figure 13: Annual rainfall totals at P-34 in southwestern Everglades National Park within subpopulation A of the Cape Sable Seaside Sparrow. Rainfall trends have been decreasing since 2006.

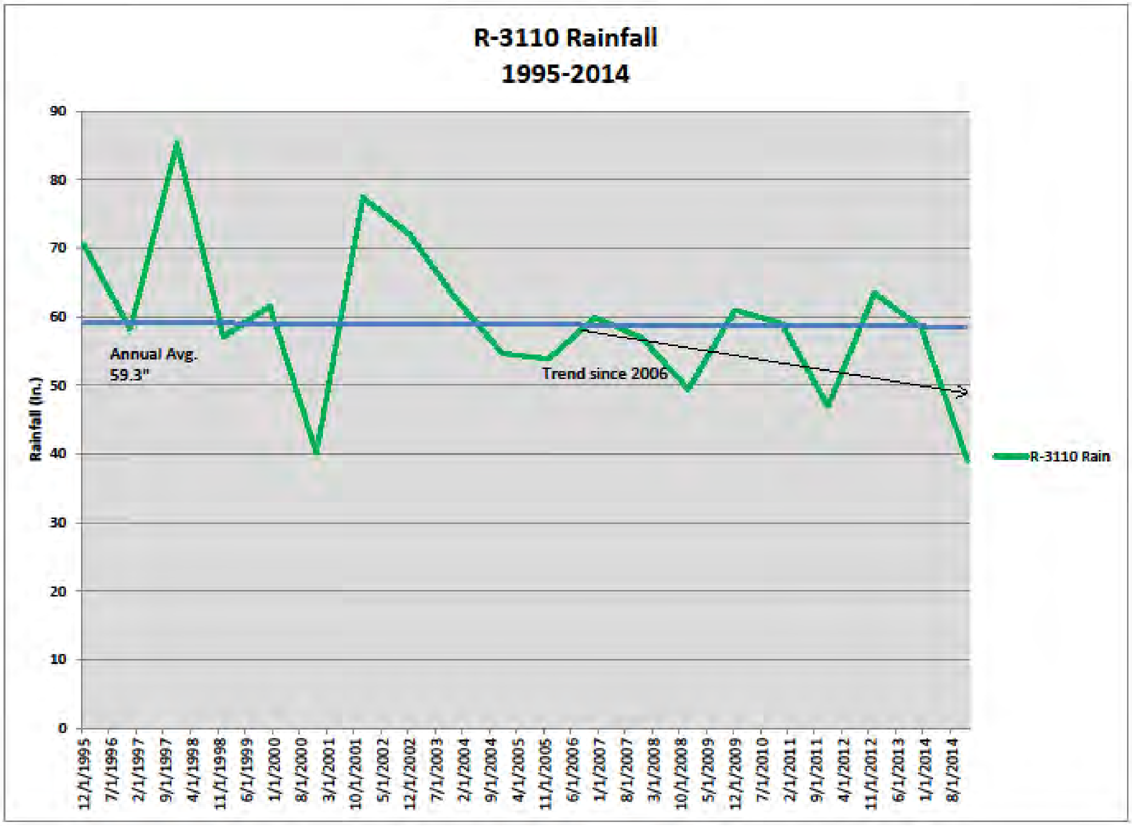


Figure 14: Annual rainfall totals at R-3110 in eastern Everglades National Park within subpopulation C of the Cape Sable Seaside Sparrow. Rainfall trends have been decreasing since 2006.

AMO Forecast

With AMO phases lasting typically 20 to 30 years, the current AMO warm phase is likely past peak. Thus, the wetter than normal conditions caused by the AMO, that Florida experienced from the early 1990s through the mid-2000's should continue to slowly decline through the next 5 to 10 years. As we approach the end of the cycle, Florida will experience an increase in drier years than wet years.

Weather and Climate Conclusions for ERTP-2016

Figure 11 illustrates annual rainfall measured by 3AVG in WCA-3A from 1965 to 2015. It is evident that we were in an overall much drier regime from 1965 to the early 1990s when the AMO transitioned from the cool phase to the warm phase. South Florida experienced more droughts and dry weather during the cool phase and more high-water events (some extreme) during the current warm phase. For ERTP-2016 planning purposes, south Florida's annual rainfall trends will continue to decline, potentially reducing harmful flooding events in CSSS habitat. However, low frequency dry and wet years will still occur due to other events such as El Nino and La Nina, which can occur on an average of every 2 to 7 years.

Rainfall Calculation Methodology

During some years of the period of record, data were incomplete for some of the 3AVG stations. For those years, rainfall totals were averaged for data complete stations. Data for 1991 is incomplete for most gauges in WCA-3A in south Florida databases. Where only one of the three sites were available or if none of the sites were complete, then rainfall data were used from the long-term 40-mile bend station on the Tamiami Trail from the National Climate Data Center. This station is located in the vicinity of extreme southwestern WCA-3A. During more recent years, incomplete rainfall totals for the 3 gauges were substituted when necessary by rainfall totals at the 40-mile bend station on Tamiami Trail.

Climate Change

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, sea level has risen, and the concentrations of greenhouse gases have increased. Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing (balance of incoming and outgoing energy), observed warming, and understanding of the climate system. Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions" (IPCC 2013).

The following scientific and ecological information on climate change and implications to the Service was summarized by the National Climate Team and staff of the Service from the 2014 publication entitled *Climate Change Impacts in the United States: The Third National Climate Assessment* (NCA) (NCA 2014). This team also summarized the 2013 publication from the IPCC entitled *Highlights of the IPCC 5th Assessment Report: The Physical Science Basis of Climate Change (WGI); Summary for Policymakers* (IPCC 2013). This information is being further condensed with a primary focus on Florida.

Florida is exceptionally vulnerable to sea level rise, extreme heat events, and hurricanes. With an ever growing population within Florida's coastal plain, annual visitors range from 10 to 15 million stressing the already decreasing water availability.

This climate change information is critical when conducting required analyses, conservation planning, and decision-making. Released by the White House on May 6, 2014, the NCA was prepared by a Federal Advisory Committee based on requirements of the Global Change Research Act of 1990.

Scenarios, Models, and Uncertainty

Our analyses under the Act include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. As defined by the IPCC, "climate" refers to average weather, typically measured in terms of the mean and variability of temperature, precipitation, or other relevant properties over time; thus "climate change" refers to a change in such a measure which persists for an extended period, typically decades or longer, due to natural conditions (e.g., solar cycles) or human-caused changes in the composition of the atmosphere or in land use (IPCC 2013). Detailed explanations of global climate change and examples of various observed and projected changes and associated effects and risks at the global level are provided in reports issued by the IPCC. Information for the United States at national and regional levels is summarized in the National Climate Assessment. Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections, we use "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it. In our analysis, we use our expert judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects.

NCA projections and information about changes in climate are based on models that assume some initial conditions called "scenarios." Two of the scenarios used in the NCA to help frame the impact analyses in a consistent way are emissions scenarios and sea level rise scenarios.

Sea Level Rise Scenarios –The NCA relied largely on scientific literature available as of 2012 regarding projections of sea level rise (SLR), ranging from about 8 inches to 6.6 feet based on different types of models and assumptions. The NCA projects that SLR will be an additional 1 to 4 feet in this century, noting that studies are still ongoing to understand processes that drive the melting of ice sheets.

Temperatures

According to the NCA, U.S. average temperatures have increased 1.3° to 1.9° F since record keeping began in 1895 (the range reflects differences in comparison methods); most of the increase has been since about 1970. The decade of 2000 – 2009 was the warmest on record and 2012 was the warmest year on record for the contiguous U.S. Temperature changes vary by location. Since 1991, average temperatures in south Florida have increased more than 1.5º F, 1º F to 1.5º F in central Florida, 0.5º F to 1º F in northern Florida, and -0.5º to +0.5º F over the Florida Panhandle.

Projected increases in average annual temperature by the late 21st century (compared to the late 20th century) vary from +3° to +7° F statewide depending on location and the emissions scenario used.

Extreme heat events in Florida are projected to increase relative to 1986-2005. By the late 21st century the average temperatures on the hottest days will likely be +3º F to +8° F higher than current temperatures. Due to human-induced emissions of GHGs that already have occurred, another +0.5° F increase in surface air temperature would be expected even if there was a sudden end to all GHG emissions caused by humans. Significantly more hot days (95°F or above) and fewer freezing events are projected. For the State of Florida, this equates to an increase in the number of hot days of more than 50 days for western and southwestern Florida, 40 to 50 additional days for the interior of Florida, and 30 to 40 additional days for Florida's coastal areas Table 2.

Table 2: Historical temperatures for Florida with projections provided through 2100.

Temperatures Since 1895	U.S.	+1.3° to +1.9°F
Temperatures Since 1991	Florida Panhandle	-0.5° to +0.5°F
	Northern Florida	+0.5° to 1.0°F
	Central Florida	+1.0° to 1.5°F
	South Florida	Greater than 1.5°F
Temperatures by 2100	Statewide	+3.0° to +7°F
Increased Extreme Heat Events	Statewide	+4.0° to +8.0°F
Increased Days over 95°F	Western Florida	Greater than +50 days
	Interior Florida	+40 to +50 days
	Eastern Florida	+30 to +40 days

Ecological Implications of Temperature Increases

On-going and projected changes in temperature vary considerably in different locations and with seasonal variations. Thus, "downscaled" projections (at the county level or finer scale) for different seasons are more suitable and useful than global, national, or regional projections of average annual temperatures.

Species and habitats vary in how they respond to increasing temperatures. For example:

- Some species are physiologically capable of tolerating increased temperature, some will be able to adjust behaviorally; some will shift their ranges if dispersal is possible; some will eventually undergo genetic changes, and some will respond in a combination of ways.
- Studies have shown that some species may initially benefit from the early stages of a warming climate, but then deteriorate (Bertelsmeier 2013).
- Microclimate conditions (e.g., climate refugia) at local scales can provide suitable locations for populations to persist even though the temperature in the surrounding area increases.
- Although some species may tolerate or adapt to increasing temperatures, there may be thresholds beyond which they are unable to adapt quickly enough, creating a risk of local or range-wide extinction due to higher temperatures or combinations with other stressors.
- For a variety of reasons, populations within a species can vary in response to increasing temperatures. We seldom have the information to identify such differences in advance, thus analyses and planning typically assume that responses will be the same.
- Species that are more tolerant of increasing temperatures may be able to outcompete and displace other species in the same area. Some invasive species of plants and animals that tolerate higher temperatures already are increasing in abundance and/or distribution, and may become competitors or predators of native species, perhaps even displacing them.
- Habitat changes also will vary in relation to temperature. In many locations vegetation composition and structure is already changing. Changes will occur on different temporal and spatial scales, and will result in changes in habitat suitability for many species
- Increasing temperatures may alter the timing of species that migrate latitudinally, causing a cascading effect on other species in that ecosystem.
- High temperatures and prolonged drought can increase the risk and extent of wildfires.

Precipitation

Precipitation patterns are changing. The NCA reports that average precipitation has increased by +5 to +10 percent since 1900 in South Florida and 0 to +5 percent in northeastern Florida. However, decreases in precipitation have occurred in central Florida and the Florida Panhandle of -5 to -10 percent.

Heavy downpours are increasing, especially over the last 30 to 50 years. Increased inland flooding is predicted during heavy rain events in low-lying areas. Increases of up to 27 percent in the frequency and intensity of these events have occurred across Florida since the 1970s.

Precipitation projections are less certain, but many models project increases in precipitation during the wet season (rainy season) across southern Florida and the Caribbean. Projections of future changes in precipitation show substantial shifts in where and how precipitation will fall. Models are in agreement regarding changes in tropical storm and hurricane rainfall events. Greater rainfall rates are expected with about a 20 percent increase near the center of storms.

Scientists continue to research the expectation of precipitation changes in other severe storms. Historical precipitation and projections for Florida through 2100 are compiled in Table 3.

Table 3: Historical rainfall patterns and projections through 2100 for Florida.

Rainfall Amounts Since 1900	Florida Panhandle	-5 to -10% of average
	Northern Florida	0 to +5% of average
	Central Florida	-5 to -10% of average
	South Florida	+5 to +10% of average
Increased Heavy Downpours since the 1970s	Statewide	+27%
Increased Annual Rainfall by 2100	Statewide	0 to +20%
Increased Dry Consecutive Days by 2100	Statewide	-10 to 20%
	South Florida	0 to +30%

Newer climate model simulations using the CMIP5 models indicate changes of precipitation seasonally for the State of Florida (Table 4).

Table 4: Newer rainfall simulations using the CMIP5 models for regions within Florida.

State Region	Winter	Spring	Summer	Fall
Panhandle	0 to -10%	0 to +10%	0 to -10%	+10 to +20%
North Florida	0 to -10%	0 to +10%	-10 to -20%	+10 to +20%
Central Florida	0 to +10%	0 to -10%	-10 to -20%	+10 to +20%
South Florida	0 to +10%	0 to -10%	-20 to -30%	+10 to +20%

Ecological Implications for Precipitation Changes

Although warming means larger amounts of water in the atmosphere, not all areas will get wetter. As discussed above, some areas could become drier. It is important to remember that climate change can trigger both droughts and floods. Flooding events will accelerate soil erosion and related impacts. Increased precipitation and/or flooding will impact certain species, such as the CSSS, wood stork and Everglades's snail kite, and their ability to forage and nest. These increases may also displace certain species.

Altered hydrology will alter sediment transport and affect species distributions, productivity, and tree island formation. Increased flood magnitudes and durations will cause stress to various habitats, causing species to adapt their behaviors in a variety of ways. It will also affect vegetation and likely cause shifts in community species composition as areas become wetter or drier as a result of precipitation changes.

Sea Level Rise

The NCA reports that global mean sea level rise (SLR) has been approximately 8 inches since 1880, the rate over the past 20 years has roughly doubled, and SLR is projected to increase another 1 to 4 ft. by the end of the 21st century. Global average SLR less than 8 inches or greater than 6.6 ft. by the end of the century is plausible.

SLR varies locally depending primarily on land subsidence or uplift in response to historic glacial activity across the continent. Storm surges and tides combine with SLR to increase flooding and erosion in many areas. SLR impacts coastal erosion, changes in sediment transport and tidal flows, more frequent flooding from higher storm surges, landward migration of barrier shorelines, fragmentation of islands, and saltwater intrusion into aquifers and estuaries.

SLR is expected to continue for many centuries at rates equal to or higher than those of this century due to past, current, and future emissions of GHGs (from human activities). GHGs result in warmer air which contributes to additional expansion of warmer ocean water and additional melt of ice sheets and glaciers. The range of the projection for another +1 to 4 ft. primarily reflects uncertainty about ice sheet melting. Historical and projected SLR is compiled in Table 5.

Table 5: Historical and projected sea level rise (SLR) through 2100.

SLR since 1880	Global	+9 inches	IPCC 2013
SLR by 2100	Global	+12 to 48 inches (+1 to 4 feet)	NCA Projections
SLR by 2100	Global	+6.7 to 15 inches	IPCC Projections
SLR by 2100	Florida Statewide	+39 inches (+3.3 feet)	Peninsular Florida Landscape Conservation Cooperative (PFLCC) Projections

Ecological Implications for Sea Level Rise

It is important to consider storm/tidal surge in combination with SLR, as storm/tidal surge impacts can be more substantial than SLR alone. Coastal areas will be increasingly impacted by SLR and storm/tidal surge. Sea level rise will increasingly lead to inundation of coastal wetlands in the region with saltwater intrusion likely through inland waterways and aquifers. Climate change is expected to increase harmful algal blooms and disease-causing agents in inland and coastal waters. Ecosystems such as tidal marshes and swamps are at risk from sea level rise. Some tidal freshwater forests are retreating, while mangrove forests are expanding.

Extreme Events

Extreme events are expected to increase in strength and frequency with accelerated climate change.

Drought

As mentioned in the Precipitation section, dry consecutive days are expected to increase 10 to 20 percent for most of Florida with up to 30 percent for South Florida.

Wildfires

In some areas, prolonged periods of record high temperatures associated with droughts contribute to dry conditions that are driving wildfires. Wildfires can cause drastic changes in species composition, changes in tree density, increased flooding and erosion risks, and decreased carbon storage capacity. The effects of climate change weaken the natural protections ecosystems have against these extreme events, making them more vulnerable.

Hurricanes

There has been a substantial increase in most measures of Atlantic hurricane activity since the early 1980s, the period during which high-quality satellite data are available. These include measures of intensity, frequency, and duration as well as the number of strongest (Category 4 and 5) storms. The recent increases in activity are linked, in part, to higher sea surface temperatures in the region that Atlantic hurricanes form in and move through. Numerous factors have been shown to influence these local sea surface temperatures, including natural variability of the Atlantic Multi-decadal Oscillation (AMO), human-induced emissions of heat-trapping gases, and particulate pollution.

Tropical storms and hurricanes are projected to be fewer in number but stronger in force, with more Category 4 and 5 hurricanes. Almost all existing studies project greater rainfall rates in hurricanes in a warmer climate, with projected increases of about 20 percent averaged near the center of hurricanes. Models also project changes in hurricane tracks and where they strike land.

Ecological Implications for Extreme Weather Events

Extreme weather events are another impact of climate change likely to cause changes in the makeup and functioning of ecosystems. Climate change makes ecosystems less resilient, or harder for them to bounce back after they are impacted by extreme disturbances such as fires, floods, and storms. The effects of changing climate on extreme events are still an active and open area of research.

Climate Change – Potential Threat to Cape Sable Seaside Sparrows, Everglade Snail Kites, and Wood Storks

Climate change could affect all of the species occurring in the Action Area. These impacts are not likely to be appreciable during the next few years, the time frame of this consultation. Nevertheless, Florida has experienced 8 to 16 inches of sea level rise in the last 70 years (Wanless et al. 1994). Projected sea level rise is 12 to 48 inches by 2100 and will exceed the design capacity for 85 percent of the water control structures installed along the coast of south Florida. These affected structures will not work on many high tides resulting in increased flooding and lost flexibility in managing the C&SF system. Eventually, climate change is likely to affect the CSSS, Everglade snail kite, and wood stork, along with many other fish and wildlife species in the future.

The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of a changing climate. Based on these findings and other similar studies, the DOI requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2009).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and by local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean). Temperatures are predicted to rise from 3^{o}C to 7^{o}C for regions of Florida by the end of this century (NCA 2014). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing, and distribution), tropical cyclones (frequency and intensity), and sea level rise. However, the exact magnitude, direction, and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current predictive models offer a wide range of predicted changes.

Climatic changes in south Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other “at risk” species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service has implemented Strategic Habitat Conservation Planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

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Appendix E – Regional Simulation Model Glades/LECSA (RSM-GL) Evaluation Methodology

Appendix E
Regional Simulation Model Glades/LECSA (RSM-GL) Evaluation Methodology

ERTP-2016 project alternatives composed of management measures (e.g., infrastructure, canal filling, and operations, etc.) were assessed using the system-wide regional hydrologic model used in the Central Everglades Planning Project (CEPP) – the Regional Simulation Model Glades LECSA (RSM-GL). The RSM-GL was the primary tool used to evaluate an array of alternatives which were compared to the Existing Condition Base (ECB16), which represents regional operations in accordance with ERTP-2016. The ECB16 was an update to the previous RSM-GL base condition runs developed for Central Everglades Planning Project (CEPP) and the District's South Dade Investigation with current features and ERTP-2016 Operations (District 2016a) as listed below:

- Priority use of S-333 for WCA-3A Rainfall Plan deliveries, followed by S-12D, S-12C, S-12B, and S-12A,
- L-28 Tie-back levee gaps and the L-28 canal plugs,
- Old Tamiami Trail borrow canal and the Tram Road east-west culvert,
- S-12 gate overtopping if headwater stage >11.0 ft. NGVD,
- Update S-12 rating curves to better match historical observations,
- Updated South Dade operations per refined operational practices within ERTP-2016.

As an additional validation step, a check was made of the RSM-GL model performance using recent rainfall and imposed WCA inflows and outflows. This step was to ensure that the model was robust in representing a variety of conditions.

Modeling Round 1

The RSM-GL provided five Round 1 scenarios relative to ECB16 (District 2016b):

- R1A - Closure of the ENP Tram Road borrow canal connection, and S-12B closure period starting on November 1 (ERTP close date is January 1) all other structures closed as per current ERTP schedule;
- R1B - Closure of the ENP Tram Road borrow canal connection, retained the July 15 opening date, and modified the closure period for S-12A, S-12B, S-343A, S-343B, and S-344 starting on October 1;
- R1C - Closure of the ENP Tram Road borrow canal connection, and open dates for S-12A, S-12B, S-343A, S-343B, and S-344 delayed to August 16 (ERTP open date is July 15);
- R1D - Closure of the ENP Tram Road borrow canal connection; closure period for S-12A, S-12B, S-343A, S-343B, and S-344 starting on October 1; and open dates for S-12A, S-12B, S-343A, S-343B, and S-344 delayed to August 16 (combination of R1B and R1C);
- R1E - Closure of the ENP Tram Road borrow canal connection and year round closure period for S-12A, S-12B, S-343A, S-343B, and S-344.

Each scenario included a variety of post processing products including annual hydroperiod and stage maps, annual stage and hydroperiod difference maps from ECB16, critical flows water control structures, duration curves, hydrographs for model cells and canals, levee seepage, monthly (April and October) stage and hydroperiod difference maps for selected years, transect flows, water supply maps, water budget maps, CSSS discontinuous hydroperiods, and CSSS consecutive dry nesting days.

Modeling Concerns from Round 1

The RSM-GL modeling tool is used to assess relative differences between the operational scenarios. The RSM-GL model has a margin of error of +/- 0.5 feet. Most of the modeling results were found within the modeling margin of error or "noise" of +/- 0.5 feet and indicated little effects to the landscape. The model grid cells are too large to capture Old Tamiami Trail Canal effects (District 2016b) or the effects of local discharges on the landscape and habitats. The S-12 structures are not well represented as there is no strong correlation between headwater elevations and flows (District 2016b). The Corps' average annual rainfall plan incorporates 300,000-400,000 acre-feet of inflow. The iModel incorporates 1.2 million acre-feet. There is a question as to whether these two varying inflows are appropriate (District 2016b).

The percent dry areas within the CSSS subpopulations are very different between EDEN and ECB16, almost double, (0.25-0.50 ft. difference). Potential causes of this discrepancy are:

1. Historical operations represented in EDEN do not include the eastward prioritization of the S-12 structures, which has been used for ERTP operations since 2014,
2. RSM-GL model cells are larger than EDEN cells, contributing to a difference in spatial distribution,
3. Ground surface elevations may differ so the District contemplated adding a model correction, which could improve model results or add more to the model's margin of error. This never occurred due to the lateness of the decision to use a hydrologic model during this consultation, and
4. The RSM-GL attempted to model ERTP operations during the period of record from 1965 to 2005. EDEN represents actual operations that were in place during the period 1992-present. Since ERTP operations did not begin until 2012, current operations are not reflected before 2012.

A sensitivity run, SENS1, moved water into Northeast Shark River Slough under pre-drainage conditions, not under CEPP or ERTP operations. In this run, the District observed no benefits of lower water at NP-205. As a matter of fact, they observed an increase of water at NP-205 at varying times. Thus, the timing of the water "push" was moved to October and November. This scenario mimics Increment 2 (INCR2) conditions (District 2016b).

Round 1 Conclusions

Out of these scenarios, the Service preferred alternative R1E, which closed S-12A/B year-round until Increment 2 of the S-356/G-3273 Field Test was implemented in the future. This would end the excessive flow of water control structure discharges into the higher ground of the western marl prairie (CSSS-A). The Corps preferred alternative R1B because it did not result in changes to the mandatory opening date (July 15) and had a more acceptable risk for structural and levee safety compared to the other scenarios in Round 1 modeling.

Four additional scenarios were then planned as a result of the Round 1 modelling:

1. iModel Run,
2. Leave S-344, S-343s, and S-12A closed year-round and have S-12B open August 16 – September 30,
3. Water Managers Adaptive Management for all Structures,
4. S-322C/D in the L-31

Modeling Round 2

Four additional model runs were produced in Round 2 of modeling (District 2016c). These assume L-29 is limited by the current 7.5 ft. NGVD stage and the G-3273 constraints are in place consistent with ERTP operations. These runs also assume closures of the ENP Tram Road borrow canal connection. The following are the additional runs:

- R2F - Year round closure period for S-12A, S-343A, S-343B and S-344; closure for S-12B from October 1 through August 15,
- R2G2 - Adaptive Management: Conditional closures of S-12A, S-12B, S-343A, S-343B and S-344 based on antecedent conditions in WCA-3A and CSSS breeding opportunity, gates tend to open as stages increase at 3A-28 (should also help to avoid "overtopping" operations), tend to close during la Nina, Neutral and weak el Nino years, and look for opportunity to deliver water to Big Cypress National Preserve during periods when it is unlikely to affect CSSS breeding opportunity. However, ERTP closures for S-12A, S-12B, and S-344 may be superseded if Oceanic Nino Index indicates moderate to strong El Nino. During these years, (in wetter ending water years in October-September) with moderate or strong el Nino conditions, structures may be operated (possibly open, but with discharge priority still east to west) under the following conditions (Corps 2016):
    - S-12A = 3 gauge average > 11.30 ft. NGVD
    - S-12B = 3 gauge average > 11.00 ft. NGVD
    - S-344 = 3 gauge average > 10.75 ft. NGVD
    - S-343 = remain closed
- R2H - Early dry season operations (September -December) informed by SFWMD South Dade study to promote more flow toward ENP and extend hydroperiods; look for later dry season opportunity (February-May) to move water toward Biscayne National Park and away from CSSS populations; attempt to avoid water level excursion above ground

surface for eastern CSSS subpopulation during March 1 to July 15 due to operation of eastern infrastructure (S-332s, S-200s, S-199s):
  - Lowering canals by ~ 0.5 ft. from August through December (operating S-332s, S-200, S-199 at lower ranges) with transition to current operations by February 15.
  - Later in dry season, promote flows toward Biscayne Bay through the S-338, S-196 and S-194 when hydraulic capacity exists

- R2I - Operations informed by iModel. This model run was not correct due to a modeling bug in the RSM-GL code. This run was completed during Round 3 of modeling, although I-model outcomes were not fully translated into the RSM-GL due to schedule limitations.

Round 2 Conclusions

The Service preferred model run R2H during this round of modeling as it indicated that conditions could be drier in the northern areas of CSSS-A and along the L-31 canal in the vicinity of the eastern subpopulations and the South Dade agricultural areas. The Corps continued to prefer alternative R1B for WCA-3A operations because it did not result in changes to the initial opening date of S-12A and S-12B (July 15) and had a more moderate risk increase for structural and levee safety due to WCA-3A high water conditions compared to some other scenarios in Round 1 and Round 2. The Corps acknowledged potential benefits to the eastern CSSS sub-populations provided by the South Dade operational changes included in R2H.

Modeling Round 3

During the Round 3 modeling, Round 2 model run "R2I", the iModel Run, was corrected and released along with six sensitivity runs for Round 1 and 2 runs R1B and R2H (District 2016d):

- Increment 1 – Removal of G-3273 constraint; L-29 stage constraint of 7.5 ft. NGVD; operational changes along eastern ENP canals and SDCS
  - INCR1B - Closure of the ENP Tram Road borrow canal connection, and closure period for S-12A, S-12B, S-343A, S-343B, and S-344 starting on October 1 and ending on July 15;
  - INCR1H - Closure of the ENP Tram Road borrow canal connection; closure period for S-12A, S-12B, S-343A, S-343B, and S-344 starting on October 1; and open dates for S-12A, S-12B, S-343A, S-343B, and S-344 delayed to August 16; plus early dry season operations (August - December) informed by SFWMD South Dade study to promote more flow toward ENP and extend hydroperiods; look for later dry season opportunity (February - May) to move water toward Biscayne National Park and away from CSSS populations; attempt to avoid water level excursion above ground surface in the eastern subpopulations during March 1 to July 15 due to operation of eastern infrastructure (S-332s, S-200s, S-199s).

- Increment 2 – Removal of G-3273 constraint, L-29 stage constraint of 8.5 ft. NGVD and the build-out of C-111 North Detention Area features (operations are intended to represent effects of Increment 2-like operations, since Increment 2 will be developed in the future based on the results from the Increment 1 field test):
  - INCR2B – Increment 2 operations with R1B operations
  - INCR2B2 – INCR2B, use of S-152 (DPM), and updated SRS demand target (i.e. new rainfall plan)
  - INCR2H – Increment 2 operations with R1B operations
  - INCR2H2 – INCR2H, use of S-152 (DPM), and updated SRS demand target (i.e. new rainfall plan)

A summary table showing operational details used within this round of modeling is located in Table 33 of the ERTP-2016 Biological Opinion.

Round 3 Conclusions

The Service preferred alternative INCR2H2 as it incorporated the existing, but refined, ERTP operations in addition to early dry season operations (September - December) informed by SFWMD South Dade study to promote more flow toward ENP and extend hydroperiods. Operations would look for later dry season opportunities (February - May) to move water toward Biscayne National Park and away from CSSS populations. Water managers would attempt to avoid water level excursion above ground surface in the eastern subpopulations during March 1 to July 15 due to operation of eastern infrastructure (S-332s, S-200s, and S-199s). However, the Corps continued to prefer alternative R1B for WCA-3A operations because it did not result in changes to the initial opening date of S-12A and S-12B (July 15) and it had a lesser risk increase for structural and levee safety compared to some other scenarios in Round 1 and Round 2. The Corps acknowledged potential benefits to the eastern CSSS sub-populations provided by the South Dade operational changes included in R2H.

Reasonable and Prudent Alternative (RPA) Selection

Discussions between the Service and the Corps led to a compromised proposed alternative scenario that is a hybrid of several model runs. No one model run incorporates the selected alternative and therefore, the Service is unable to do a complete analysis on the hybrid alternative. However, the Service will analyze the various model runs and infer effects on the species.

The RPA will focus the water management operating strategy around model run R1B (S-12 A/B, S-343 A/B, and S-344 closure period from October 1 to July 15). The R1B model run will be accompanied with an exit strategy for October and November that was developed by the Corps to reduce their risk of structural overtopping during the late wet season. Under this strategy, if water levels are high in WCA-3A in October, the S-12A/B could remain or be opened until water levels drop. If water levels are high in WCA-3A during November, the S-12B could remain open or be opened until water levels drop. S-343A/B and S-344 would close on October 1 regardless of water level conditions. South Dade operations in model run R2H will also be a part of the alternative for protection of the eastern marl prairie and subpopulations. The L-29 constraint of 7.5 ft. NGVD will be raised to 7.8 ft. NGVD by March 1, 2017, and to 8.5 ft. NGVD by March 1, 2018.

Exit Strategy for S-12A/B

An exit strategy for the opening of S-12A/B beyond the official closing date of October 1 is proposed by the Corps for times when water levels are considered high in WCA-3A (Corps 2016). The following WCA-3A outlet structures will close by default on October 1:

- S-12A (previously closed by November 1),
- S-12B (previously closed by January 1),
- S-343A/B (previously closed by November 1), and
- S-344 (previously closed by November 1).

However, the exit strategy would allow S-12A and/or S-12B to be conditionally opened during October and/or November to limit the duration of WCA-3A high water stages, in accordance with the following criteria:

- Proposed Criteria for S-12A/B Opening and Closure in October:
    - WCA-3A 3-avg stage on September 30 > 10.50 ft. NGVD; or
    - WCA-3A 3-avg stage projected to rise above 10.75 ft. NGVD (IOP Zone A) during October, based on consideration of projected inflows including direct rainfall.
    - S-12A and/or S-12B will be closed when WCA-3A 3-avg stage falls below 10.25 ft. NGVD or on November 1, whichever occurs first.

- Proposed Criteria for S-12B Opening and Closure during November:
    - WCA-3A 3-avg stage on October 31 > 11.00 ft. NGVD; or
    - WCA-3A 3-avg stage projected to rise above 11.25 ft. NGVD during November, based on consideration of projected inflows including direct rainfall.
    - S-12B will be closed when WCA-3A 3-avg stage falls below 10.75 ft. NGVD or on December 1, whichever occurs first.

The Corps estimated the frequency of occurrence of the exit strategy using both the modeled alternative and historically observed WCA-3A water level conditions. The period of record used for frequency estimates by the model was 1965-2005 and the period of record used with observed data was 1962-2015. The following frequencies were calculated by the Corps:

- Model: Years with S-12A/B remaining open in October was 12 of 41 years (29 percent), meaning S-12A/B were closed on October 1 during 71 percent of the years.
- Model: Years with S-12B remaining open in November was 5 of 41 years (12 percent), meaning S-12A/B were closed on November 1 during 88 percent of years.
- Observed: Historical Years with S-12A/B remaining open in October was 13 of 54 years (25 percent).

- Observed: Historical Years with S-12B remaining open in November was 9 of 51 years (18 percent).

The Service has requested that the Corps provide a strategy for pre-emptively operating structures in order to avoid the need for the exit strategy openings of the S-12A/B. The Service requests that discharges prior to October 1 be aggressive enough to allow as much water to be moved towards the east as possible. Pre-emptive operations should strive to avoid S-12A/B openings in October and November, when practicable.

Model Alternatives for Species Effects

Since conditions will be changing each year as we implement the Increment 1 and 2 operations, the Service evaluated Increment 1 with R1B (INCR1B) and R2H (INCR1H) for 2017 when analyzing the model results for the species. The Service analyzed the effects of INCR1B on the western marl prairie and CSSS-A, and WCA-3A for snail kites and wood storks during 2017. INCR1H results were used to analyze the effects to the eastern marl prairie and CSSS subpopulations during 2017. For 2018, the Service analyzed the effects of INCR 2 with R1B (INCR2B) on the western marl prairie and CSSS-A, and WCA-3A for snail kites and wood storks. INCR2H was used to evaluate the effects on the eastern marl prairie and CSSS subpopulations. In summary, this means INCR1B and INCR1H, with increased L-29 stages (7.8 ft. NGVD) along with South Dade operations, will be used for the 2017 analysis and INCR2B and INCR2H, with increased L-29 stages (8.5 ft. NGVD) along with South Dade operations, will be used for the 2018 analysis.

Model Uncertainty

There are many uncertainties involved in the use of hydrologic models and although significant effort has been invested into the development and calibration of these models, recognition of model uncertainty is needed when interpreting the ecological significance of model results (Corps 2013). There is uncertainty in the predictions derived from these models that stems from input variability and measurement errors, parameter uncertainty, model structure uncertainty, and algorithmic (numerical) uncertainty. These uncertainties lead to doubt as to whether the specific performance indicators and measures accurately captures the overall performance. The likelihood of capturing all the processes occurring in a system as complex as the Everglades within simulation models is low. There will always be some uncertainty present in predicting environmental benefits associated with any CERP project because of the size and complexity of the Everglades ecosystem, as well as the difficulty in fully understanding its physical and biological processes.

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Appendix F – ERTP-2016 Proposed Operational Scenario

Appendix F

ERTP-2016 Proposed Operational Scenario

30 June 2016

Based on evaluation of the regional modeling conducted in support of the ERTP-2016 consultation, the following components [(I) through (V)] are included in the proposed operational scenario. The proposed operational scenario includes components selected from the following modeling scenarios: Round 1 Scenario B (R1B); Round 2 Scenario H (R2H); and the Round 2 sensitivity scenarios used to assess performance under a potential MWD Increment 2 scenario (Scenarios INCR2B, INCR2B2, INCR2H, and INCR2H2).

Component (I) and component (II) of the operational scenario require modifications to the 2012 Water Control Plan (2012 WCP). Modifications will be implemented by the Corps through a planned deviation to the 2012 WCP following completion of the requisite NEPA and approvals, currently anticipated in October 2016.

I. WCA-3A outlet structures S-12A, S-12B, S-343A, S-343B, and S-344 will close on 01 October and will remain closed through 14 July, except under the following conditions (A and B) when additional WCA-3A discharges from S-12A and/or S-12B are necessary to limit the duration of WCA-3A high water stages:

A. S-12A and/or S-12B will be conditionally opened during October under the following conditions:
    1. WCA-3A stage on 30 SEP > 10.50 feet NGVD; OR
    2. WCA-3A stage projected to rise above 10.75 feet NGVD (IOP Zone A) during October, based on consideration of projected inflows including direct rainfall.

   S-12A and/or S-12B will be conditionally closed when the WCA-3A stage falls below 10.25 feet NGVD, OR on 01 November, whichever comes first.

B. S-12B will be conditionally opened during November under the following conditions:
    1. WCA-3A stage on 31 OCT > 11.00 feet NGVD; OR
    2. WCA-3A stage projected to rise above 11.25 feet NGVD during November, based on consideration of projected inflows including direct rainfall.

   S-12B will be closed when the WCA-3A stage falls below 10.75 feet NGVD, OR on 01 December, whichever comes first.

Following completion of the requisite NEPA and approvals, the revised seasonal closure periods and "high water strategy" criteria specified above would supersede the seasonal closure periods identified in the 2012 WCP for ERTP; the previous ERTP seasonal closure requirements specified in the 2012 WCP are 01 November through 14 July for S-12A, S-343A, S-343B, and S-344, and 01 January through 14 July for S-12B. Based on consideration of pertinent new information and/or additional technical analyses, the “high water strategy” criteria may be further adjusted prior to final implementation through an update to the WCP or a planned deviation.

All other operational criteria for S-12A, S-12B, S-12C, and S-12D will remain unchanged from the operations specified in the 2012 WCP, including the S-12A cultural access release of up to 100 cfs. S-12A up to 100 cfs release may only be requested by the Miccosukee Tribe of Indians when the Tribe is unable to access cultural areas within ENP. Also unchanged from the 2012 WCP criteria, if the headwater elevation at S-12A or S-12B is greater than 11.0 feet NGVD, the corresponding S-12 structure gate(s) may be opened an amount only enough to stop overtopping of gates; if the S-12A and/or S-12B gates are opened under this condition, that gates would be closed when the corresponding headwater elevations falls below 10.75 feet NGVD, AND the WCA-3A 3AS3W1 monitoring stage is below 11.00 feet NGVD.

The default operational criteria for closure of the WCA-3A outlet structures S-12A, S-12B, S-343A, S-343B, and S-344 between 01 October and 14 July were included in the R1B modeling scenario. The “high water strategy” criteria were developed by the Corps to mitigate for the increased frequency and duration of WCA-3A high water stages in excess of the 90th percentile of historical water stages, compared to the 2012 WCP/ERTP, associated with these expanded closure periods; the 90th percentile water level varies seasonally and reaches a maximum of 11.5 feet NGVD during the month of October. Levee safety concerns and the risk of overtopping to the perimeter levees are exacerbated with higher water levels in WCA-3A and are most vulnerable during the later parts of the wet season (July, August, September and early October), which coincides with the height of the hurricane season. The results of the Corps’ Baseline and Modification Modeling (BAMM) regional flood routing study are expected to be available in late 2017 to provide further technical analysis and quantification of potential risk to WCA levees and water control structures. Pending completion of the BAMM regional flood routing study, the Corps will carefully monitor trends in WCA-3A water elevations and weather forecasts to assess any potential risks to health and safety posed by wind and waves caused by storms and hurricanes, as informed by Appendix A-5 to the 2011 ERTP Final Environmental Impact Statement.

II. The following South Dade Conveyance System (SDCS) water control structure operations will supersede the operations specified in the 2012 WCP. All other operational criteria for the SDCS water control structures shall remain unchanged from the operations specified in the 2012 WCP. The operational criteria for the water control structures listed within section (II) were not previously modified under the MWD Increment 1 temporary planned deviation to the 2012 WCP. Based on consideration of pertinent new information and/or additional technical analyses identified during NEPA, the operational criteria for these SDCS water control structures may be further adjusted prior to final implementation through an update to the WCP or a planned deviation. The operational criteria indicated below were included in the R2H modeling scenario.

A. S-338
    1. During CSSS nesting window from 16 February through 31 July: open 5.3 feet NGVD / close 4.9 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);
    2. SDCS Column 2 mode of operations from 01 August through 15 February: open 5.4 feet NGVD / close 5.0 feet NGVD;
    3. SDCS Column 1 mode of operations from 01 August through 15 February: open 5.8 feet NGVD / close 5.5 feet NGVD (unchanged from 2012 WCP).

B. S-332B and S-332C
    1. During CSSS nesting window from 15 February through 31 July: open 5.0 feet NGVD / close 4.7 feet NGVD (open/close triggers unchanged from 2012 WCP);
    2. Outside of CSSS nesting window from 01 August through 31 December: open 4.5 feet NGVD / close 4.2 feet NGVD (open/close triggers are lowered 0.5 feet from 2012 WCP Column 1 operations; operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);
    3. Prior to the CSSS nesting window, operations will transition linearly from criteria (2) to criteria (1) during the 6-week period from 31 December through 15 February;
    4. In order to promote gradual transitions within the adjacent ENP wetlands, the electric pump or the first diesel pump unit at S-332BN (up to 125 cfs from S-332B to Northern Detention Area), S-332B (up to 125 cfs from S-332B to Southern Detention Area), and S-332C (up to 125 cfs) may be operated using the following trigger criteria:
        i. During CSSS nesting window from 15 February through 31 July: open 4.7 feet NGVD / close 4.5 feet NGVD (operational guidelines unchanged from 2012 WCP, with close trigger matching 2012 WCP Column 2 criteria);
        ii. Outside of CSSS nesting window from 01 August through 31 December: open 4.2 feet NGVD / close 4.0 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);
        iii. Prior to the CSSS nesting window, operations will transition linearly from criteria (ii) to criteria (i) during the 6-week period from 31 December through 15 February.

C. S-332D
    1. During CSSS nesting window From 15 February through 31 July: open 4.85 feet NGVD / close 4.65 feet NGVD (open/close triggers unchanged from 2012 WCP);
    2. Outside of CSSS nesting window from 01 August through 31 December: open 4.35 feet NGVD / close 4.15 feet NGVD (open/close triggers are lowered 0.5 feet from 2012 WCP Column 1 operations; operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);

3. Prior to the CSSS nesting window, operations will transition linearly from criteria (2) to criteria (1) during the 6-week period from 31 December through 15 February;
4. S-332D Discharge limitations to Taylor Slough (unchanged from 2012 WCP):
    i. Deliver up to 500 cfs from 15 July (or the end of the breeding season, as confirmed by FWS) through 30 November; deliver up to 325 cfs from 01 December through 31 January; and deliver up to 250 cfs from 1 February through 14 July;
    ii. S-332DX1 may be used to re-direct a portion of S-332 pump discharges into the Southern Detention Area, consistent with seasonal constraints on water deliveries to Taylor Slough under (i);

5. In order to promote gradual transitions within the adjacent ENP Taylor Slough wetlands, the first diesel pump unit at S-332D will be operated using the following trigger criteria:
    i. During CSSS nesting window from 15 February through 31 July: open 4.65 feet NGVD / close 4.5 feet NGVD (operational guidelines unchanged from 2012 WCP, with open trigger set slightly lower than S-332B/S-332C (to facilitate S-332D priority) and close trigger matching 2012 WCP Column 2 criteria at S-332B/S-332C);
    ii. Outside of CSSS nesting window from 01 August through 31 December: open 4.15 feet NGVD / close 4.0 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);
    iii. Prior to the CSSS nesting window, operations will transition linearly from criteria (ii) to criteria (i) during the 6-week period from 31 December through 15 February.

D. S-194 and S-196
    1. During early CSSS nesting window from 16 February through 15 May: open 4.5 feet NGVD / close 4.0 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);
    2. During late CSSS nesting window from 01 June through 31 July: open 4.8 feet NGVD / close 4.3 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations);
    3. Operations will transition from criteria (1) to criteria (2) during the 2-week period from 15 May through 01 June;
    4. SDCS Column 2 mode of operations from 01 August through 15 February: open 4.8 feet NGVD / close 4.3 feet NGVD;
    5. SDCS Column 1 mode of operations from 01 August through 15 February: open 5.5 feet NGVD / close 4.8 feet NGVD (unchanged from 2012 WCP).

E. S-176
    1. SDCS Column 1 mode of operations: open 5.0 feet NGVD / close 4.75 feet NGVD (unchanged from 2012 WCP);

2. SDCS Column 2 mode of operations: open 4.9 feet NGVD / close 4.7 feet NGVD (unchanged from 2012 WCP);
3. September 01 through 31 December: S-176 may be opened to release up to an additional 200 cfs while maintaining C-111 Canal stages between 4.55 and 4.80 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations). Implementation details for these operations will be further developed concurrent with the requisite NEPA assessment.

F. S-177
1. SDCS Column 1 or Column 2 mode of operations: open 4.2 feet NGVD / close 3.6 feet NGVD (unchanged from 2012 WCP);
2. September 01 through 31 December: S-177 may be opened to release up to an additional 200 cfs while maintaining C-111 Canal stages between 3.2 and 3.9 feet NGVD (operations are independent of whether other SDCS operations are under Column 1 or Column 2 mode of operations). Implementation details for these operations will be further developed concurrent with the requisite NEPA assessment.

III. The USACE will also employ operational flexibility within the 2012 WCP, based on the guidelines listed below. The operational flexibility available to the Corps within the 2012 WCP was previously documented in the Corps' July 2015 Biological Assessment for ERTP-2016.

A. When conditions allow, USACE will delay opening and/or implement early closure of S-12A, S-12B, S-343A, S-343B and S-344 structures beyond the required seasonal closure periods specified under component I (default closure period from 01 October through 14 July) to further limit flow into western Shark River Slough; the minimum required seasonal closure periods for these water control structures are specified under component I and summarized below:
1. S-12A: Required closure period from 01 November though 14 July; required seasonal closure will be extended from 01 October through 14 July if the "high-water strategy" criteria specified under component I are not triggered;
2. S-12B: Required closure period from 01 December though 14 July; required seasonal closure will be extended from 01 October through 14 July if the "high-water strategy" criteria specified under component I are not triggered;
3. S-343A, S-343B, and S-344: Closed from 01 October though 14 July.

B. Discharge capacity from S-333 into NESRS will be maximized prior to utilization of the S-12 structures.

C. When flows through the S-12 structures are determined necessary by the WCA-3A Regulation Schedule and the Rainfall Plan, USACE will prioritize flow through the easternmost S-12 structures as capacity allows, in order to minimize flow through the S-12A and S-12B structures. This prioritization of the S-12 structures assumes that flows through the S-333 structure into NESRS are already at capacity or have reached an associated constraint.

1. If additional releases from WCA-3A are required and S-333, S-12D and S-12C are already operated at capacity, then S-12B may be utilized for the required release.

2. If additional releases from WCA-3A are required and S-333, S-12D, S-12C, and S-12B are already operated at capacity, then S-12A may be utilized for the required release.

3. Releases through the S-12A and S-12B structures will only occur outside their mandated closure periods, with the exception of when the headwater elevation at S-12A or S-12B is greater than 11.0 feet NGVD. Consistent with the 2012 WCP, under this condition, the corresponding S-12 structure gate(s) may be opened an amount only enough to stop overtopping of gates; if the S-12A and/or S-12B gates are opened under this condition, that gates would be closed when the corresponding headwater elevations falls below 10.75 feet NGVD, AND the WCA-3A 3AS3W1 monitoring stage is below 11.00 feet NGVD.

D. Flexibility associated with preemptive releases will assist to maintain target stages within WCA-3A and allow for further flexibility in discharges through the S-12 and S-333 structures. Preemptive releases are used to create storage within WCA-3A when large adjustments to inflow into WCA-3A or large regional rainfall events are forecasted.

1. Preemptive release amounts are calculated based upon expected inflows into WCA-3A from WCA-1/WCA-2 outlet structures (i.e. S-10s/S-11s) and/or forecasted regional rainfall events. When either of these events is predicted to occur, USACE may utilize the WCA-3A outlet structures to include the available S-12s and S-333 structures to create storage within WCA-3A; if S-12A and/or S-12B are closed based on the criteria listed under Component I, S-12A and/or S-12B would not be operated for preemptive releases.

2. Discharges from WCA-3A will be discontinued as the weekly (or other interval) Rainfall Plan target flow calculations dictate. Implementation of preemptive releases will result in an accounting of the amount of water released in excess of the Rainfall Plan target flows.

E. The order of S-332B, S-332C and S-332D pumping will be prioritized base on coordination with the FWS, SFWMD and ENP.

1. This flexibility will be used to promote an increased number of consecutive dry days within CSSS habitat during the nesting window as requested by FWS and to promote a 90-210 day discontinuous hydroperiod within CSSS habitat.

2. Local rainfall patterns, antecedent conditions and operations will be discussed in real-time to determine pumping prioritization.

IV. To further prevent westward flow of water into CSSS-A, the 2011 ERTP FEIS also included blocking of the Old Tamiami Trail Borrow Canal culvert between S-12C and S-12B, at the junction with the Shark Valley Tram Road. Authority to purchase, install, monitor and maintain this feature resides with the U.S. Department of the Interior (DOI). Due to potential effects on the WCA-3A discharge capacity (most notably during high water conditions) and concerns previously indicated by the Miccosukee Tribe, this action will be closely coordinated by DOI with the Corps. The closure of the Old Tamiami Trail Borrow Canal culvert was included in all modeling scenarios, including R1B, R2H, INCR2B, INCR2B2, INCR2H, and INCR2H2. Closure of this structure is most critical during the mandated closure period for S-12A and S-12B to minimize any potential effects of S-12C and/or S-12D operations on water levels within the CSSS-A habitat area, to complement the closure of the culverts along the ENP Tram Road.

V. The Corps has planned several steps to allow more water from WCA-3A to move to the east and under the Tamiami Trail Bridge into Shark River Slough including raising the maximum stage in the L-29 canal. To accomplish this, the Corps will develop and adopt water operations plan that allows the L-29 stage to be expeditiously raised. Starting with "Increment 1 Plus," "Increment 2," and the "Combined Operational Plan" (COP).

A. The Corps will proceed as scheduled for completing NEPA analysis on "Increment 1 Plus" (raising L-29 canal levels up to 7.8) and, as allowable by law, raising L-29 canal levels to 7.8 ft NGVD prior to March 1, 2017;

B. The Corps will proceed as scheduled for completing NEPA analysis on "Increment 2" NEPA (raising L-29 up to 8.5) and, as allowable by law, raising L-29 canal levels to 8.5 ft NGVD prior to March 1, 2018;

C. The Corps will proceed as scheduled for completing NEPA analysis on "COP" in 2019;

D. Upon conclusion of each NEPA, the Corps will promptly adjust water management operations.

VI. The Corps will provide a strategy for pre-emptively operating structures in order to avoid the need for the high-water criteria openings of the S-12A/B. Discharges prior to October 1 will be aggressive enough to allow as much water to be moved towards the east as possible. Pre-emptive operations should strive to avoid S-12A/B openings in October and November, when practicable.

Appendix G – Draft Scope of Work for the L-28 Study

Appendix G
Draft Scope of Work for the L-28 Study

1 Stage of Planning Process

The U.S. Army Corps of Engineers (Corps) has not initiated this study. The Corps will develop a refined scope, schedule and budget in coordination with a multiagency team once a non-Federal Sponsor has been identified.

2 Study Authority

The Corps identified two potential authorities under which to pursue modifications to L-28 to reduce adverse effects of Central and Southern Florida Project features or operations on endangered Cape Sable seaside sparrow, subpopulation A (CSSS-A). These authorities include:

> Continuing Authorities Program, Section 1135, Water Resources Development Act of 1986, as amended – Project Modifications for Improvement of the Environment:

The term "Continuing Authorities Program" or "CAP" means a group of 9 legislative authorities under which the Secretary of the Army, acting through the Chief of Engineers, is authorized to plan, design, and implement certain types of water resources projects without additional project specific congressional authorization. For projects pursued under Section 1135, a non-Federal sponsor may be an entity that meets the "public body" requirement of Section 221, or may be a non-profit entity. In either event, the non-Federal sponsor must have the full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. As with a public body non-Federal sponsor, a non-profit entity that serves as the non-Federal sponsor must be able to demonstrate not only its capability to participate during design and implementation of the project but also its long-term commitment and capability to finance and perform any necessary Operations, Maintenance, Repair, Replace and Rehabilitation activities. Further, as required by Federal statute, the affected local government must consent to a non-profit entity being the non-Federal sponsor for an 1135 project. Section 1135 Federal Participation limit is $10,000,000.

CERP Program Authority:

§ 385.13 Projects implemented under additional program authority. (a) To expedite implementation of the Plan, the Corps of Engineers and non-Federal sponsors may implement projects under the authority of section 601(c) of WRDA 2000 that are described in the Plan and that will produce a substantial benefit to the restoration, preservation, and protection of the South Florida ecosystem. (b) Each project implemented under the authority of section 601(c) of WRDA 2000 shall: (1) In general, follow the process described in § 385.11; (2) Not be implemented until a Project Implementation Report is prepared and approved in accordance with § 385.26; and (3) Not exceed a total cost of $25,000,000. (c) The total aggregate cost of all projects implemented under the additional program authority shall not exceed $206,000,000.

It must be noted that the Corps is concerned with potential L-28 modifications that could benefit CSSS-A may not be adequately "described in the Plan" to implement under CERP Program Authority.

3 Study Area

The study area includes Water Conservation Area 3A (WCA-3A), western Everglades National Park and eastern Big Cypress National Preserve (BCNP) (Figure 1). Specific study components include borrow canals and bridges along Tamiami Trail and Loop Road, L-28 Canal, WCA-3A outlet water control structures, L-28 Tie-back Levee gaps and WCA-3A seepage. The L-28 Interceptor Canal will be included within the Western Basins Restoration Initiative.

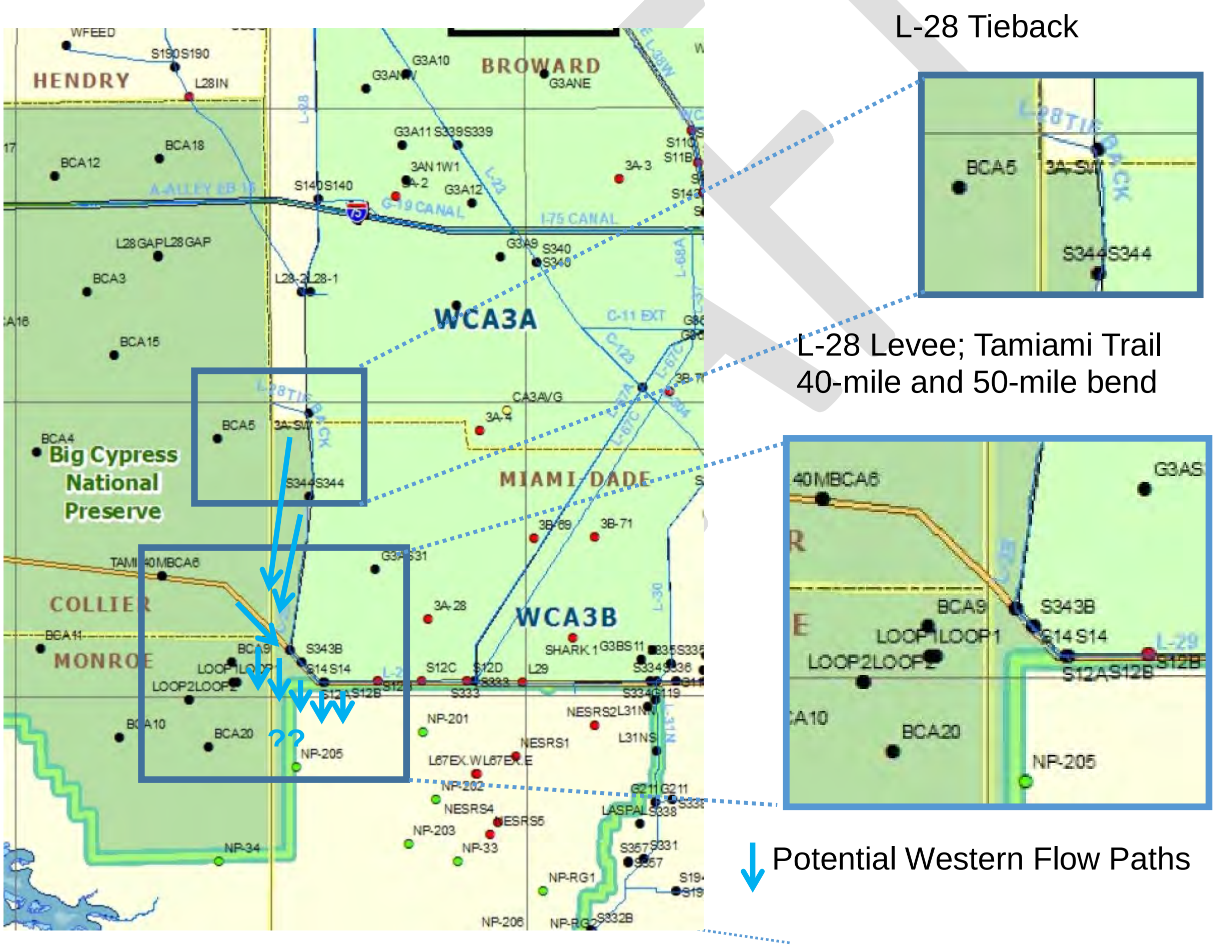

Figure 1. Location of L-28 Study

4 Non-Federal Sponsor

Potential non-Federal sponsors include South Florida Water Management District, Florida Fish and Wildlife Conservation Commission and Florida Department of Transportation.

5 Problems/Opportunities

During consultation with FWS and BCNP, it was suggested that the L-28 Borrow Canal was partially implicated in delivery of water flow into the western marl prairie and CSSS-A habitat. Since western flows have been suggested as having an adverse effect on CSSS-A, the Corps will undertake a planning study to determine whether the L-28 Levee, L-28 Tie-back Levee, L-28 Borrow Canal or other structures along Tamiami Trail or Loop Road require modification in order to reduce conveyance into western CSSS-A, while potentially providing benefits to wetlands within BCNP.

Potential effects from western flows on CSSS-A were analyzed by the Corps during Combined Structural and Operational Plan Endangered Species Act coordination with FWS during 2006-2007 including presentations to the 2007 Avian Ecology Workshop. Western flows were also revisited by the Corps and FWS during ERTP coordination in 2010-2011. When WCA-3A water levels are high, BCNP water flows from Mullet Slough may combine with water flows through gaps previously constructed in the L-28 Tieback Levee, with the resulting southerly flows funneled east of the Miami-Dade JetPort through the 40-mile bend area. Portions of this water, along with local runoff from eastern BCNP and water within the L-28 Borrow Canal, may be collected by the Tamiami Trail borrow canal (north side of road) and directed through Tamiami Trail bridges and Loop Road bridges into Everglades National Park near CSSS-A. Historical hydrograph responses at NP-205 showed a high degree of correlation to upstream hydrograph at gauge BCNP A-9 during periods of S-12 closures (**Figure 2**). Vegetation mapping also indicated transition from prairie-marsh to marsh vegetation as more prevalent along western CSSS-A. The gaps in the L-28 Tieback Levee were originally constructed for purposes of rehydrating BCNP and referenced a 1992/1993 U.S. Geological Survey report. The gaps were constructed in the early 1980s.

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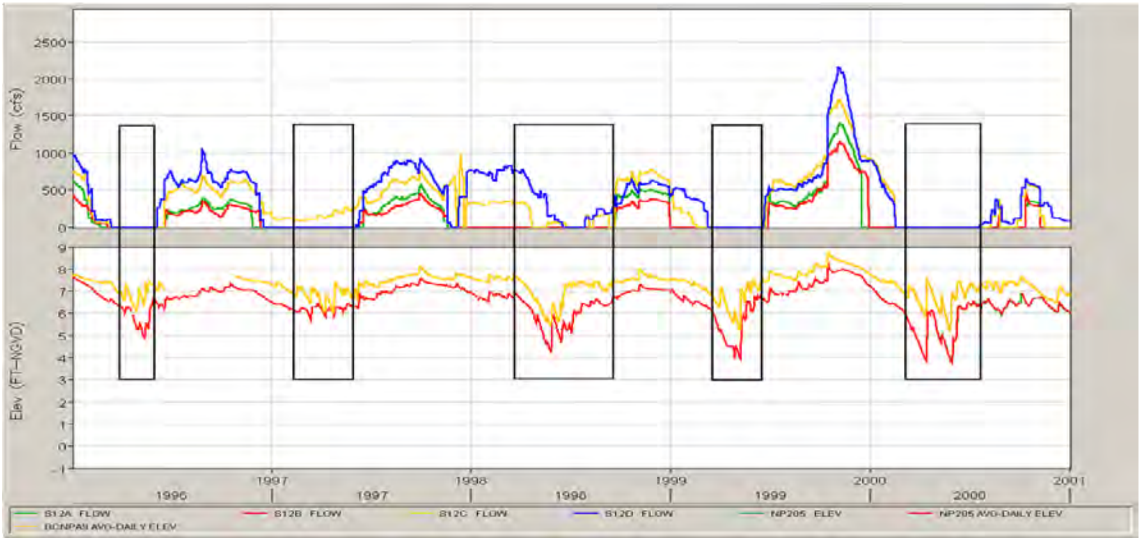

Figure 2. Historical hydrograph responses at Gauge NP-205 and Gauge BCNP A-9 during periods of S-12 closures.

5.1 Problem

The problem to address is adverse effects of western flows on CSSS-A that contribute to reduction in number of dry nesting days and an increase in hydroperiod, particularly within the western portions of CSSS-A.

5.2 Opportunities

Opportunities include reducing flows to western CSSS-A and potentially rehydrating portions of BCNP.

6 Planning Purpose/Objectives

The purpose of the L-28 Study is to characterize how surface water moves within the western Everglades National Park watershed and eastern BCNP in order to implement management measures to reduce adverse hydrologic effects on endangered CSSS and its habitat west of Shark River Slough.

Planning objectives include:

- Identify preferential flow paths, with primary focus on flows paths affecting CSSS-A core habitat areas.
- Evaluate effects from WCA-3A and BCNP discharges and hydrographs.

7 Planning Constraints

Any potential modifications to L-28 need to be compatible with Water Conservation Area Interim Risk Reduction Measure (Zone A modifications).

8 Formulating Alternative Plans

Formulation of alternative plans will follow the Corps' Six-Step Planning Process. In short, an Interagency Team will:

1. Identify Problems and Opportunities
2. Perform Inventory of Existing Data, identify data needs; forecast conditions
3. Formulating Alternative Plans
   - Determine potential management measures to address planning objectives
   - Eliminate less promising management measures
   - Combine management measures into plans by using formulation strategies
4. Evaluate Alternative Plans
   - Iteratively screen and reformulate plans
5. Compare Alternative Plans
6. Select Plan
   - Define Monitoring and Adaptive Management Options.
   - Define Measurements of Success

8.1 Management Measures

An Interagency Team will assess potential management measures listed below during the L-28 Planning Study. Management measures are structural or non-structural features or activities that address one or more planning objectives. This list is not meant to be exhaustive and the Interagency Team will undergo a brainstorming session to determine additional potential management measures to address planning objectives.

a. Add earthen plug, Flap Gate Culvert or pump in Tamiami Borrow Canal near Pine Crest.
b. Add culverts in western Loop Rd (south of the BCNP A-9 gauge).
c. Reduce bridge flows along eastern Loop Rd and shift flows west by improving Loop Rd borrow canal.
d. Backfill up to 8 miles of L-28 Borrow Canal. (Explore options for fill source(s)).
e. Initially, the question of raising the elevation of six plugs currently within L-28 Borrow Canal south of S-344, including consideration of plug stabilization and armoring was recommended. But this measure was completed in May 2016 under the State's emergency order.
f. Change bottom elevation of Loop Road borrow canal to facilitate westward flow of water.
g. Additional bridging/culverts on Loop Road.

h. Raise elevation within L-28 gaps compatible with WCA-3A Interim Risk Reduction Measures.
i. Construct C&SF authorized L-28 Extension Canal (extending 5 miles southwest of S-12A).
j. Extend L-28 Tieback Levee to the west and southwest towards the Miami-Dade Jetport.
k. Extend L-28 Levee southwest to create flow-way berm to direct water away from CSSS-A.
l. Raze Jet Port to remove impediment to westward flow (11.5 Mile Road/Jetport-culvert modifications?)
m. Plug/Backfill of Tamiami Trail Borrow Canal between L-28 and S-12A
n. 343s/344-changes in operations (if successful with reduction in adverse effects of L-28 water flow on CSSS-A, there may be potential to change operations of S-343s, S-344 to provide water to Big Cypress?)
o. Revisit options from March 1997 L-28 Report

8.2 Screening of Measures

Management measures outlined in Section 8.1 will undergo an initial screen process to identify feasible management measures. Retained management measures will then undergo a rigorous screening analysis to evaluate, optimize, refine, and finally group into components (i.e. one or more management measures that can be implemented at a specific geographic site) and options (i.e. a grouping of one or more components that function together to provide a sub-regional restoration approach to address objectives and avoid constraints).

Management measures may be eliminated from further analysis based upon criteria such as severe and obvious adverse impacts, dominated measures (i.e. same output at less cost or greater output for the same cost) as well as other factors as described by the Interagency Team. Remaining management measures will be screened based upon completeness, effectiveness, efficiency and acceptability.

8.3 Initial Array of Alternative Plans

To be developed in conjunction with Interagency Team.

8.4 Evaluation of Alternative Plans

To be developed in conjunction with Interagency Team.

8.5 Selection of Plan

To be developed in conjunction with Interagency Team. Interagency Team will also develop and implement Monitoring and Adaptive Management Plan as appropriate and identify metrics for measuring success.

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9 Timeline

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