ENDANGERED SPECIES ACT SUPPLEMENTAL BIOLOGICAL ASSESSMENT

Everglades Restoration Transition Plan

Prepared by
Department of the Army
Jacksonville District Corps of Engineers

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EXECUTIVE SUMMARY

On February 19, 1999, the U.S. Fish and Wildlife Service (FWS) issued a Final Biological Opinion (BO) under the provisions of the Endangered Species Act (ESA) of 1973, as amended, for actions required to assure the survival of the endangered Cape Sable seaside sparrow (CSSS or sparrow;), as affected by operation of components of the Central and Southern Florida (C&SF) Project in Miami-Dade County. The BO required rapid implementation of structural and operational changes to existing constructed portions of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) Project and the Canal-111 South Dade Project (C-111 SD), which were then operating under Test 7 of the Experimental Program of Water Deliveries to ENP. The BO concluded that continuation of Test 7, Phase I operations would cause adverse modification of CSSS critical habitat and would jeopardize the sparrow's continued existence. The BO presented a Reasonable and Prudent Alternative (RPA) that would avoid jeopardizing CSSS. The RPA recommended that the following hydrological conditions be met for protection of CSSS: (1) a minimum of 60 consecutive days of water levels at or below 6.0 feet National Geodetic Vertical Datum (NGVD) would have to be achieved at the NP-205 gauge (the NP-205 gauge is representative of conditions within CSSS subpopulation A; CSSS-A) between March 1 and July 15; (2) the U.S. Army Corps of Engineers (USACE) would have to ensure that 30%, 45%, and 60% of required regulatory releases crossing Tamiami Trail enter ENP east of the L-67 Extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of CSSS subpopulations C, E, and F that meet or exceed those produced by the 30%, 45%, and 60% targets; and (3) produce hydroperiods and water levels in the vicinity of CSSS subpopulations C, E, and F that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase II operations (USACE 1995), and implement the entire MWD Project no later than December 2003. Operations described within the 2002 Interim Operational Plan for Protection of the CSSS (IOP) Final Environmental Impact Statement (FEIS), 2006 IOP Final Supplemental Environmental Impact Statement (FSEIS), and the 2002 and 2006 IOP BOs were consistent with the 1999 RPA.

IOP was intended to be continued until the completion of MWD Project, however, MWD Project components and associated real estate acquisitions have not been fully completed and the 2006 IOP BO only covered impacts through November 2010. For these reasons, in addition to relevant new species information, USACE initiated consultation in 2009 on the Everglades Restoration Transition Plan (ERTP). The purpose of ERTP is to define operations for the constructed features of MWD and Canal 111 South Dade (C-111 SD) projects until those projects are fully completed and a Combined Operational Plan (COP) is implemented. ERTP, which was implemented in October 2012, is a modification of IOP with operational flexibilities to provide further hydrological improvements amenable to multiple listed species. ERTP is intended to cover operations until the full implementation of COP, which will be implemented upon the completion of MWD Project and C-111 SD Project features. ERTP represents a paradigm shift over IOP. IOP consisted predominantly of closure periods on the S-12 structures to manage for a single endangered species, CSSS. In contrast, ERTP incorporates operational flexibility and adaptive management to better manage Water Conservation Area 3A (WCA-3A) for the benefit of multiple species, including endangered snail kite and threatened wood stork. ERTP integrated consideration of new information consisting of current climatological, hydrological and species conditions, project specific performance measures and ecological targets, and Periodic Scientists Calls (PSC), along with closure periods on the S12A-B structures to maintain nesting conditions for CSSS.

In July 2010, due to stakeholder concerns regarding high water levels in WCA-3A and discharge limitations of the S-12s, USACE, Jacksonville District, Water Resources Engineering Branch conducted a review of the C&SF Part 1 Supplement 33 General Design Memorandum (GDM) for (June 1960) and the C&SF Part 1 Supplement 49: Agricultural and Conservation Areas General and Detail Design Memorandum (August 1972). Based upon the results of their review, USACE concluded that a rigorous evaluation of the Standard Project Flood (SPF) conditions within WCA-3A is needed to consider changed operational parameters as compared to the original design assumptions (USACE 2010). USACE proposed a two-phase analysis approach that included the identification and assessment of interim water management criteria for WCA-3A, including operational changes proposed 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 spillways, 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. The Phase 2 WCA-3A flood routing analysis, which includes the Baseline and Modification Model, or BAMM, is currently underway. The intent of 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 original 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 WCA. The BAMM flood routing results will be used by USACE to conduct comprehensive risk analysis of levees and structures within each WCA, including hydraulic and hydrological, geotechnical and structural engineering disciplines, if results warrant. The USACE 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 would be used with other regional hydrologic modeling tools to evaluate mitigation options, if necessary. The current expected completion date for BAMM is September 2017. Until the results of BAMM are available, including further analysis and quantification of risk to WCA levees and structures, USACE is not proposing any changes to the WCA-3A Regulation schedule within this Supplemental Biological Assessment. In addition, USACE is not proposing any changes to the mandated closure periods for the S-12A, S-12B, S-343A, S-343B or S-344 structures within this Supplemental Biological Assessment due to the potential effects of additional closure periods on water elevations within WCA-3A.

Species and critical habitat identified during consultation as potentially affected by the continued implementation of ERTP include twenty-nine federally listed threatened or endangered species, along with designated critical habitat for seven of those species. USACE previously provided a Draft Biological Assessment on ERTP to FWS in June 2010 and a Final Biological Assessment October 15, 2010. Based upon information contained within the USACE Biological Assessment, FWS provided a BO November 17, 2010 concluding formal consultation on ERTP. A subsequent BO Amendment was provided March 2, 2012 to specifically address USACE concerns with wood stork incidental take triggers as expressed by USACE verbally and by email January 24, 2011. A full consultation history on water management activities to protect CSSS is contained within the 2010 ERTP Biological Assessment, 2010 ERTP BO and 2011 ERTP FEIS and is hereby incorporated by reference.

The purpose of this Supplemental Biological Assessment under ESA of 1973, as amended, is to determine potential effects of continued operations under 2012 ERTP on the endangered CSSS, and is being undertaken as a result of an exceedance of an Incidental Take Reinitiation Trigger from the November 17, 2010 ERTP BO. The 2010 ERTP BO Incidental Take Reinitiation Trigger states "*If the annual CSSS population estimate falls below 2,915 sparrows [Mean population estimate 2001-2009 = 3,145 ± 230]), reinitiation of consultation must occur.*" Based upon preliminary data collected by ENP as part of the 2014 CSSS range-wide survey, it appears that the annual population estimate of CSSS has fallen below the reinitiation trigger defined within the November 17, 2010 ERTP BO. Therefore, pursuant to requirements of the 2010 ERTP BO, USACE formally requested reinitiation of consultation in a letter to FWS dated November 17, 2014.

USACE has identified five main reasonable and prudent measures under USACE authority that may act to further protect CSSS. USACE is committed to implementing these five main reasonable and prudent measures; therefore, water management operations for the next several years will include the following reasonable and prudent measures for protection of the endangered CSSS: 1) MWD Project Increment 1 Field Test; 2) implementation of operational flexibility within ERTP to protect CSSS; 3) a Water Flow Analysis Test; 4) MWD Increment 2 Field Test; and 5) Combined Operational Plan (i.e. MWD Increment 3). In addition, USACE will prepare an assessment, using an interagency team, of potential effects of Levee 28 (L-28) Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, USACE has not yet determined what authority might be required for such action. The MWD Project Increment 1 Field Test includes relaxation of Gauge 3273, a Term and Condition of the November 17, 2010 ERTP BO. As part of the MWD Project Increment 1 Field Test, USACE will conduct a spreadsheet tracking analysis to quantify how revised operations under MWD Increment 1 Field Test reduce flows through the S-12A, S-343A, S-343B, S-344 and S-12B structures.

USACE will also employ operational flexibility within ERTP to include maximizing flows through the S-12 structures from the east to the west as capacity allows. This flexibility will ensure that regulatory releases from WCA-3A are prioritized to the east to the extent practicable to reduce flows into western Shark River Slough where CSSS-A resides. In addition, when conditions allow, USACE 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 CSSS restriction dates to further limit flow into western Shark River Slough (refer to **Appendix D**, for details). In order to provide increased benefits to CSSS populations east of Shark River Slough, USACE will work in conjunction with FWS and our State sponsor, South Florida Water Management District, to alter the order of pumping at the S-332B, S-332C and S-332D structures to meet CSSS needs when conditions allow (refer to **Appendix D** for details). This flexibility will be used to promote an increased number of consecutive dry days within CSSS habitat as requested by FWS (90 or more consecutive dry days, March 3, 2015 FWS letter) to allow increased potential for breeding. In addition, this flexibility will be used to promote a 90-120 day discontinuous hydroperiod within CSSS habitat. Finally, ERTP 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.

USACE recognizes that until completion of the Comprehensive Everglades Restoration Plan (CERP), there are few opportunities within the current constraints of the C&SF system to completely avoid impacts to listed species. However, the proposed set of reasonable and prudent measures are intended to serve as a transition from ERTP to COP to CERP. This transitional approach allows USACE to take advantage of the best science currently available and to better balance the competing needs of multiple species, as compared to the single-species emphasis embodied in IOP. Although continued implementation of the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the previous operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered snail kite and threatened wood stork. Pursuant to Section 7 of the ESA of 1973, as amended, USACE is requesting formal consultation with FWS regarding the determinations within this Supplemental Biological Assessment.

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LIST OF ACRONYMS

95 Base	Test Iteration 7 of the Experimental Program of MWD to ENP (referenced as the 1995 Base)

A

B

BCNP	Big Cypress National Preserve
BO	Biological Opinion

C

C-111	Canal-111
C-111 SD	C-111 South Dade
C-x	Canal
C&SF	Central & Southern Florida Project
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
COP	Combined Operational Plan
CSSS	Cape Sable seaside sparrow (or sparrow)
CSSS-x	Cape Sable seaside sparrow subpopulation

D

DEIS	Draft Environmental Impact Statement
DOI	Department of the Interior

E

EIS	Environmental Impact Statement
ENP	Everglades National Park
ERTP	Everglades Restoration Transition Plan
ESA	Endangered Species Act
ET	Ecological Target

F

FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
FWC	Florida Fish and Wildlife Conservation Commission
FWS	U.S. Fish and Wildlife Service
FSEIS	Final Supplemental Environmental Impact Statement
FWS	U.S. Fish and Wildlife Service

G

G-x	Gauging Station or Culvert Structure
GDM	General Design Memorandum
GRR	General Reevaluation Report

H

I

IOP	Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow
ISOP	Interim Structural and Operational Plan

J

K

KCOL	Kissimmee Chain of Lakes

L

L-x	Levee

M

MSTS	Multi-Species Transition Strategy
MWD	Modified Water Deliveries (to ENP)

N

NEPA	National Environmental Policy Act
NESRS	Northeast Shark River Slough
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service

O

P

PL	Public Law
PM	Performance Measure

Q

R

ROD	Record of Decision
RPA	Reasonable and Prudent Alternative

S

S-x	Pump Station, Spillway or Culvert
SDCS	South Dade Conveyance System (ENP)
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SMA	Square Mile Area

SPF Standard Project Flood

T

U

USACE U.S. Army Corps of Engineers

V

W

WCA Water Conservation Area
WCA-3AVG Water Conservation Area 3 Gauge Average
WCP Water Control Plan

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1 INTRODUCTION

The purpose of a Biological Assessment is to evaluate the potential effects of a federal action on both listed species and those proposed for listing, including designated and proposed critical habitat, and determine whether the continued existence of any such species or habitat is likely to be adversely affected by the federal action. The Biological Assessment is also used in determining whether formal consultation or a conference is necessary [Federal Register 51 (106): Section 402.1 (f), pg. 19960, 3 June 1986]. This is achieved by:

- Reviewing the results of an on-site inspection of the area affected by the federal action to determine if listed or proposed species are present or occurs seasonally.
- Reviewing the views of recognized experts on the species at issue and relevant literature.
- Analyzing the effects of the federal action on species and habitat including consideration of cumulative effects, and the results of any related studies.
- Analyzing alternative actions considered by the federal agency for the proposed action.

2 CONSULTATION SUMMARY

On June 30, 2009, Everglades Restoration Transition Plan (ERTP) team members of U.S. Army Corps of Engineers (USACE) met with representatives of U.S. Fish and Wildlife Service (FWS) to discuss effects of the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow (IOP) from 2002 to 2009 on threatened and endangered species and their designated critical habitat and develop a scope for ERTP. USACE and FWS, along with members from Everglades National Park (ENP), South Florida Water Management District (SFWMD) and the Miccosukee Tribe of Indians of Florida conducted weekly or bi-weekly meetings from July 2009 through April 2010 to review empirical hydrological, meteorological and ecological data from IOP operations, in order to define an array of water management actions to improve conditions for snail kite (*Rostrhamus sociabilis*) and wood stork (*Mycteria americana*), while maintaining protection of Cape Sable seaside sparrow (CSSS) (*Ammodramus maritimus mirabilis*). In addition, monthly meetings (September 2009-January 2010) were held with other governmental agencies including Florida Fish and Wildlife Conservation Commission (FWC), Florida Department of Environmental Protection (FDEP), Florida Department of Agriculture and Consumer Services and Miami-Dade Department of Environmental Resources Management. After January 2010, these agencies were invited to participate in all ERTP team meetings. After April 2010, USACE continued to consult with FWS on proposed ERTP operations through October 2010.

USACE originally consulted with FWS by letter dated January 21, 2010 on federally listed threatened and endangered species that may be present in the ERTP action area. In a letter dated March 8, 2010, FWS provided partial concurrence with USACE finding of listed species that may be encountered or adjacent to the action area and provided a list of other federally threatened and endangered species, along with candidate species, potentially likely to occur within the action area. In 2010, federally threatened and endangered species that may occur within the ERTP action area included Florida panther (*Puma concolor coryi*), Florida population of West Indian Manatee (Florida manatee) (*Trichechus manatus*), CSSS, snail kite, red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork, American alligator (*Alligator mississippiensis*), American crocodile (*Crocodylus acutus*), Eastern indigo snake (*Drymarchon corais couperi*), crenulate lead-plant (*Amorpha crenulata*), deltoid spurge (*Chamaesyce deltoidea* ssp. *deltoidea*), Garber's spurge (*Chamaesyce garberii*), Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeenis*), Small's milkpea (*Galactia smallii*), tiny polygala (*Polygala smallii*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), and Stock Island tree snail (*Orthalicus reses* [not incl. *nesodryas*]). In addition, ERTP action area contains designated critical habitat for American crocodile, snail kite, CSSS and Florida manatee.

On June 16, 2015, USACE consulted with FWS by letter to reconfirm listed species within the ERTP action area. By letter dated July 16, 2015, FWS amended the list of species to include those identified within **Table 2**. As a result of this reconfirmation, additional species were added to the list of species that have the potential to occur within the ERTP action area. These additional species include Florida bonneted bat (*Eumops floridanus*), Miami blue butterfly (*Cyclargus thomasi bethunebaker*), Bartram's hairstreak butterfly (*Strymon acis bartrami*) and its designated critical habitat, Florida leafwing butterfly (*Anaea troglodyta floridalis*) and its designated critical habitat and Cape Sable thoroughwort (*Chromolaena frustrata*) and its designated critical habitat. In the same July 16, 2015, FWS removed piping plover (*Charadrius melodus*), crenulate lead plant, deltoid spurge, Small's milkpea, tiny polygala, Big Pine partridge pea (*Chamaecrista lineata* var. *keyensis*), Carter's small-flowered flax (*Linum carteri* var. *carteri*), Florida brickell-bush (*Brickellia mosieri*), Florida prairie clover (*Dalea carthagenensis*), Florida semaphore cactus (*Opuntia corallicola*) and sand flax (*Linum arenicola*) from the USACE June 16, 2015 proposed list. Due to the fact that within the 2010 ERTP Biological Assessment, USACE concluded that ERTP implementation may affect deltoid spurge, Garber's spurge, Small's milkpea and tiny polygala, an effects determination for these species has also been included within this Supplemental Biological Assessment.

Federally listed species under the purview of National Marine Fisheries Service (NMFS) include green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), smalltooth sawfish (*Pristis pectinata*), elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*) and Johnson's seagrass (*Halophila johnsonii*). USACE coordinated with NMFS pertaining to potential action effects on listed species under their purview (March 2010, July 2015). In addition, the action study area contains designated critical habitat for green sea turtle, leatherback sea turtle, smalltooth sawfish, elkhorn coral, staghorn coral and Johnson's seagrass.

The USACE provided a Draft Biological Assessment to FWS in June 2010 and a Final Biological Assessment October 15, 2010 (**Appendix A**). Based upon information contained within the USACE Biological Assessment, FWS provided a BO November 17, 2010 concluding formal consultation on ERTP. A subsequent BO Amendment was provided March 2, 2012 to specifically address USACE concerns with wood stork incidental take triggers as expressed by USACE verbally and by email January 24, 2011. A full consultation history on water management activities to protect CSSS is contained within the 2010 ERTP Biological Assessment, 2010 ERTP BO and 2011 ERTP Final Environmental Impact Statement (FEIS) and is hereby incorporated by reference.

In accordance with the Terms and Conditions contained within the 2010 ERTP BO, USACE is required to provide an annual assessment of ERTP operations. This annual assessment includes a summary of Periodic Scientists Calls (PSC), analysis of incidental take, analysis of ERTP performance measures and ecological targets and species monitoring. The Incidental Take Statements, Terms and Conditions and Reinitiation Notice are defined in the 2010 ERTP BO. Species monitoring reports are provided to FWS upon USACE receipt from Principal Investigators (those performing monitoring requirements) in accordance with monitoring contract schedules. In accordance with the Terms and Conditions outlined within the 2010 ERTP BO, USACE provided an annual assessment for Water Year 2011 (October 1 2010-September 30, 2011) on October 26, 2011; Water Year 2012 (October 1, 2011-September 30, 2012) on November 15, 2012; Water Year 2013 (October 1, 2012-September 30, 2013) on December 17, 2013; and Water Year 2014 (October 1, 2013-September 30, 2014) on November 17, 2014.

In addition to the required monitoring, USACE has also implemented, or is in the process of implementing, Conservation Recommendations contained within the 2010 ERTP BO. The USACE continues to monitor on a daily basis a series of existing hydrological gauges and has installed a new hydrological monitoring gauge, SPARROW-1, south of the S-12A structure within ENP (Refer to Conservation Recommendation 1, 2010 ERTP BO). In cooperation with FWS, other Federal and State Agencies, Federally-recognized Tribes and the public, USACE has also worked extensively on Conservation Recommendation 2 to explore ways to increase outlet capacity of Water Conservation Area 3A (WCA-3A) and WCA-3B via the S-333 and S-355 structures, as authorized and envisioned as part of the Modified Water Deliveries (MWD) Project and Comprehensive Everglades Restoration Plan (CERP). USACE received an operational permit for permanent operation of the S-355 structures from FDEP June 8, 2015, thereby providing another option to alleviate high water concerns within WCA-3B.

In 2012, USACE implemented an accelerated planning process to improve conditions within the central everglades. The Central Everglades Planning Project (CEPP), a component of the CERP, is designed to improve quantity, quality, timing and distribution of water flow throughout the central everglades to include WCA-3A, WCA-3B and ENP. This project, once implemented, will restore the historical flow path to the extent practicable through WCA-3B and NESRS given other project constraints (e.g. flood mitigation). However, during CEPP ESA consultation, it was noted that restoration of historical flow into ENP could have potentially adverse impacts on CSSS due to rehydration of wetlands resulting in greater depths and longer periods of inundation. Adverse effects were noted for subpopulations A, C, D, and E; however, CEPP modeling also revealed areas in which habitat conditions would be suitable for future colonization by CSSS in areas adjacent to current subpopulation locations.

Consistent with Conservation Recommendation 2, USACE is expected to implement MWD Increment 1 Field Test in August 2015 to provide greater flow through the S-333 structure into NESRS within ENP. Significantly, included within the MWD Increment 1 Field Test is relaxation of the G-3273 constraint which is a Term and Condition of the 2010 ERTP BO (refer to Term and Condition 1, 2010 ERTP BO). During the MWD Increment 1 Field Test, USACE will utilize a spreadsheet tracker to track flows through S-333 and the S-12s structures in order to quantify reductions in flow through the S-12A, S-12B, S-343A, S-343B and S-344 structures realized from implementation of MWD Increment 1 Field Test, which may further assist to promote conditions conducive to CSSS nesting.

In accordance with the 2010 ERTP BO, USACE continues to hold PSC on regular basis during the breeding season and on an as-needed basis throughout the remainder of the year. During Water Year 2013 (October 1, 2012 through September 30, 2013), 13 PSC were convened and 14 PSC were convened in Water Year 2014 (October 1, 2013 through September 30, 2014) to discuss ecological conditions within the WCAs and ENP, to provide updates on species breeding status and locations and to make water management recommendations to benefit multiple listed species within the greater Everglades. A summary of each PSC including recommendations, ecological conditions and water management actions are included within the 2013 and 2014 ERTP Annual Assessments (**Appendix B**). In addition to PSC, FWS held a series of Multispecies Transition Strategy meetings during 2013 and 2014. The purposes of these meetings were to review monitoring data provided by USACE Principal Investigators (along with other Federal and State agencies), to understand antecedent and predicted future hydrometeorological conditions within the greater Everglades, to review previous breeding season success and to make a series of water elevation recommendations to facilitate species needs.

In addition, during ESA Consultation on CEPP, a number of actions were identified that could help improve the ability to estimate CSSS abundance, enhance CSSS habitat and promote stability across CSSS subpopulations. As a result, the Department of the Interior, including FWS, ENP and United States Geological Survey, have implemented a CSSS Memorandum of Understanding (MOU). This MOU outlines steps that Department of the Interior agencies will undertake to better understand the biology of CSSS and implement strategies to improve CSSS resiliency in the light of future hydrological conditions from implementation of CERP projects as well as sea level rise. For additional information, please refer to 2013 CEPP BO (FWS 2013a).

USACE reinitiated ESA consultation on ERTP on November 17, 2014 as a result of an exceedance of an Incidental Take Reinitiation Trigger from the November 17, 2010 ERTP BO. The 2010 ERTP BO Incidental Take Reinitiation Trigger states "*If the annual CSSS population estimate falls below 2,915 sparrows [Mean population estimate 2001-2009 = 3,145 ± 230]), reinitiation of consultation must occur.*" Based upon preliminary data collected by ENP as part of the 2014 CSSS range-wide survey, it appears that the annual population estimate of CSSS has fallen below the reinitiation trigger defined within the November 17, 2010 ERTP BO. Therefore, pursuant to requirements of the 2010 ERTP BO, USACE formally requested reinitiation of consultation in a letter to FWS dated November 17, 2014.

In a letter dated December 12, 2014, FWS acknowledged receipt of USACE reinitiation request and stated that "*it has become apparent to the Service that further modifications to the current water management regime are needed to conserve and recover sparrows*". The December 12, 2014 letter also included comments from the Water Year 2013 ERTP Annual Assessment. On January 26, 2015, USACE responded to FWS December 12, 2014 letter stating that USACE is committed to looking for reasonable and prudent measures to further protect CSSS to the extent practicable through water management operations; but also clarifying that it is widely recognized that ERTP and its predecessor, 2002-2012 IOP, were not designed to recover CSSS, but instead, as measures to protect the subspecies during its breeding season from unfavorable water levels. The letter also addressed specific FWS comments on the Water Year 2013 ERTP Annual Assessment. On March 3, 2015, FWS responded with a list of potential conservation measures to explore along with a request to increase the number of consecutive dry days from 60 to 90 or more consecutive dry days throughout a large portion of CSSS habitat in successive years along with average annual hydroperiod of 90-120 days in CSSS habitat. USACE acknowledged during several informal meetings with FWS that it would use its operational flexibility under ERTP to promote conditions favorable for CSSS nesting and hydroperiod requirements. In addition, in light of FWS March 3, 2105 letter, USACE requested reaffirmation of FWS support for MWD Increment 1 Field Test as well as use of ERTP operational flexibility in a March 27, 2015 letter. FWS provided reaffirmation of support for MWD Increment 1 Field Test as well as use of operational flexibility under ERTP in a letter dated May 22, 2015. Operational flexibility will be used to promote an increased number of consecutive dry days within CSSS habitat as requested by FWS to allow increased potential for breeding. In addition, this flexibility will be used to promote a 90-120 day discontinuous hydroperiod within CSSS habitat.

Since USACE reinitiated consultation, several technical team meetings have been held with FWS and other DOI agencies including ENP, United States Geological Survey and BCNP. In addition, USACE has also consulted with the Miccosukee Tribe of Indians of Florida, Seminole Tribe of Florida, South Florida Water Management District, the local sponsor for the C&SF Project; along with other State agencies to address reasonable and prudent alternatives measures to protect CSSS. During the consultation process, several near-term (6-12 months), mid-term (2-5 years) and long-term (greater than 5 years) reasonable and prudent measures were identified that could potentially be undertaken by USACE and other Federal and State agencies that would protect and enhance CSSS populations. These reasonable and prudent measures are further discussed under Section 6 and require a concerted effort on behalf of State and Federal agencies to implement reasonable and prudent measures under their agency's authorities.

As part of the informal consultation process following USACE reinitiation request of November 17, 2014, FWS requested that USACE further restrict S-12A and S-12B operations to protect CSSS-A. In order to analyze the potential effects of the FWS request on water management operations and water elevations within WCA-3A in particular, USACE evaluated four different S-12A, S-343A, S-343B, S-344, and S-12B closure periods as illustrated in **Table 1**. The evaluations estimated the potential effect of each operational scenario on historical WCA-3A stages for each water year during historical IOP and ERTP operations (water years 2003-2015). The evaluations assumed the flow volumes that were historically released from the WCA-3A outlet structures (S-12A, S-12B, S-343A, S-343B, and S-344) during the extended closure periods identified for each scenario were instead retained within the WCA-3A storage volume. Although potential effects on WCA-3A stages varied in response to annual hydrologic conditions, all four scenarios demonstrated multiple years with WCA-3A stage increases greater than 0.2-0.3 feet; for relative comparison, it is critical to note that the WCA-3A stage reductions resulting from the WCA-3A Regulation Schedule changes during ERTP were also estimated at 0.2-0.3 feet during normal to wet conditions.

Based upon the results of this evaluation, it was concluded that due to potential high water concerns within WCA-3A and the fact that the BAMM WCA flood routing analysis has not been completed, USACE could not commit to additional mandated closure periods that may act to increase the peak stage and increase the frequency and duration of high water conditions within WCA-3A. Alternatively, USACE can use existing operational flexibility inherent within ERTP in order to minimize use of the S-12A, S-12B, S-343A, S-343B and S-344 structures as conditions permit. A full evaluation of FWS requested operational scenarios was provided to FWS on March 26, 2015 with further evaluation provided to FWS on April 29, 2015.

TABLE 1. STRUCTURE CLOSURE PERIODS EVALUATED AT FWS REQUEST

Operational Scenario	Structural Changes
1: Structures Close 1 month early	S-12A, S-343A, S-343A, S-344 close October 1; S-12B close December 1
2: Structures Open 1 month later	S-12A, S-12B, S-343A, S-343B, S-344 open August 15
3: Structures close 1 month early AND open 1 month late	S-12A, S-343A, S-343B, S-344 close October 1 AND open August 15; S-12B close December 1 AND open August 15
4: Structures closed all year	S-12A, S-12B, S-343A, S-343B and S-344 closed year round

3 ACTION DESCRIPTION

3.1 ACTION AUTHORITY

A minimum schedule of water deliveries from C&SF Project to ENP was authorized by Congress in 1970 by Public Law 91-282. The Supplemental Appropriations Act of 1984, Public Law 98-181, authorized USACE, with the concurrence of the National Park Service and SFWMD, to deviate from the minimum delivery schedule for two years in order to conduct an Experimental Program of water deliveries to improve conditions within ENP. The Energy and Water Development Appropriations Act of 1992, Public Law 102-104 allowed continuation of the Experimental Program until modifications to the C&SF Project authorized by Section 104 of the ENP Protection and Expansion Act of 1989, Public Law 101-229, were completed and implemented. The Tamiami Trail component of the MWD Project was completed in 2013, providing for increased water deliveries to ENP through a route that more closely approximates the original historic flow-way through the center of Northeast Shark River Slough (NESRS).

The MWD General Design Memorandum (GDM) and FEIS were published in July 1992 (**Figure** 1). The MWD FEIS includes a discussion of the location, capacity, and environmental impacts for the proposed structural modifications, which included S-345A, B and C; S-349A, B and C; S-355A and B; S-334 modification, removal of L-67 Extension and borrow canal filling; and a levee and canal system for flood mitigation in the developed East Everglades area (also referred to as the 8.5 Square Mile Area or 8.5 SMA). The levee and canal system included two pumping stations, S-356 and S-357. The MWD GDM recommended plan provides a system of water deliveries to ENP across the full width of the historic Shark River Slough flow way. The C-111 South Dade (C-111 SD) 1994 Integrated General Re-evaluation Report (GRR) and Environmental Impact Statement (EIS) was published in May 1994. This report described a conceptual plan for five pump stations and levee-bounded retention/detention areas to be built east of the L-31N Canal between the 8.5 SMA and the Frog Pond (area south and east of the L-31W Canal) to control seepage out of ENP while maintaining flood protection for agricultural lands east of C-111 Canal (C-111). The original 1994 GRR plan and current configuration of these C-111 SD structural features is further discussed in the description of IOP Alternative 7R, within the 2006 Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow (IOP) Final Supplemental Environmental Impact Statement (FSEIS).

Test Iteration 7 of the Experimental Program of MWD to ENP (herein referenced as the 1995 Base or 95Base)) was initiated in October 1995 (USACE 1995). In February 1999, FWS issued a Final BO under provisions of the ESA, which concluded that Test 7, Phase I was jeopardizing the continued existence of the CSSS. FWS further concluded that ultimate protection for the species would be achieved by implementing the MWD Project (PL 101-229) as quickly as possible. In the opinion of FWS, the 1999 FWS BO presented a Reasonable and Prudent Alternative (RPA) to Test 7, Phase I of the Experimental Program that would avoid jeopardizing CSSS during the interim period leading up to completion of the MWD Project. The FWS RPA recommended that certain hydrologic conditions be maintained in CSSS's breeding habitat to avoid jeopardizing the continued existence of the species. In March 2000, Test 7, Phase I was replaced by the Interim Structural and Operational Plan (ISOP) (USACE 2000). ISOP was designed to meet the conditions of the FWS RPA included in the FWS BO from March 2000 until implementation of IOP in 2002. The Record of Decision (ROD) for IOP was signed in July 2002, and IOP was implemented to continue the FWS RPA protective measures for the CSSS. Because of the need to have an operational plan in place prior to the CSSS breeding season, the 2002 IOP EIS and ROD were finalized prior to completion of modeling for Alternative 7R. Pursuant to a March 14, 2006 order by the United States District Court for the Southern District of Florida, USACE supplemented its 2002 IOP EIS with the 2006 IOP FSEIS. The IOP BO only covered impacts through November 2010. For this reason, in addition to relevant new species information, USACE initiated formal consultation on ERTP in 2009. A Draft Biological

Assessment was provided to FWS in June 2010 and a Final Biological Assessment October 15, 2010, concluding that implementation of ERTP may affect CSSS, snail kite and wood stork. The FWS issued a BO on ERTP on November 17, 2010 concurring with USACE species effects determinations and concluding that ERTP would not result in jeopardy to CSSS, snail kite or wood stork; or adverse modification of CSSS or snail kite designated critical habitat. Based upon concerns voiced by USACE regarding the Incidental Take Trigger for wood stork, an Amendment to the ERTP BO was issued March 2, 2012 revising Incidental Take for wood stork. The 2010 ERTP BO Incidental Take Reinitiation Trigger for CSSS states "*If the annual CSSS population estimate falls below 2,915 sparrows [Mean population estimate 2001-2009 = 3,145 ± 230]), reinitiation of consultation must occur.*" Based upon preliminary data collected by ENP as part of the 2014 CSSS range-wide survey, it appears that the annual population estimate of CSSS has fallen below the reinitiation trigger defined within the November 17, 2010 ERTP BO. Therefore, pursuant to requirements of the 2010 ERTP BO, USACE formally requested reinitiation of consultation in a letter to FWS dated November 17, 2014.

3.2 DESCRIPTION OF PROPOSED ACTION

The Action currently under consultation is continued implementation of ERTP to include five main reasonable and prudent measures under USACE authority that may act to further protect CSSS. USACE is committed to implementing these five main reasonable and prudent measures; therefore, water management operations for the next several years will include the following reasonable and prudent measures for protection of the endangered CSSS: 1) MWD Project Increment 1 Field Test; 2) implementation of operational flexibility within ERTP to protect CSSS; 3) a Water Flow Analysis Test; 4) MWD Increment 2 Field Test; and 5) Combined Operational Plan (i.e. MWD Increment 3). In addition, USACE will prepare an assessment, using an interagency team, of potential effects of Levee 28 (L-28) Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, USACE has not yet determined what authority might be required for such action. The MWD Project Increment 1 Field Test includes relaxation of Gauge 3273, a Term and Condition of the November 17, 2010 ERTP BO. As part of the MWD Project Increment 1 Field Test, USACE will conduct a spreadsheet tracking analysis to quantify how revised operations under MWD Increment 1 Field Test reduce flows through the S-12A, S-343A, S-343B, S-344 and S-12B structures.

In addition, USACE will also employ operational flexibility within ERTP to include maximizing flows through the S-12 structures from the east to the west as capacity allows. This flexibility will ensure that regulatory releases from WCA-3A are prioritized to the east to the extent practicable to reduce flows into western Shark River Slough where CSSS-A resides. In addition, when conditions allow, USACE will delay opening and/or implement early closure of the S-12A, S-343A, S-343B, S-344 and S-12B structures beyond their current CSSS restriction dates to further limit flow into western Shark River Slough. In order to provide increased benefits to CSSS populations east of Shark River Slough, USACE will work in conjunction with FWS and our State sponsor, SFWMD, to alter the order of pumping at the S-332B, S-332C and S-332D structures to meet CSSS needs when conditions allow. This flexibility will be used to promote an increased number of consecutive dry days within CSSS habitat as requested by FWS (90 or more consecutive dry days, March 3, 2015 FWS letter) to allow increased potential for breeding. In addition, this flexibility will be used to promote a 90-120 day discontinuous hydroperiod within CSSS habitat. Finally, ERTP 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.

USACE is also planning to implement a Water Flow Analysis Test in order to identify potential sources of water entering western Shark River Slough. The results of this test could be used to formulate reasonable and prudent measures to address water flow into CSSS-A habitat. It is important to note that USACE has not identified authority to implement these measures which would require National Environmental Policy Act (NEPA) documentation and compliance with other applicable environmental laws and regulations.

Finally, during consultation with FWS and BCNP, it was suggested that the L-28 Borrow Canal was partially implicated in delivery of water flow into western CSSS-A. Since western flows have been suggested as having an adverse effect on CSSS-A, particularly within its western region, USACE will prepare an assessment, using an interagency team, 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, USACE has not yet determined what authority might be required for such action.

3.3 ACTION OBJECTIVE, PERFORMANCE MEASURES AND ECOLOGICAL TARGETS

The overall action objective of ERTP is to maximize operational flexibilities in order to improve conditions for snail kite, wood stork and other wading birds and their habitats in south Florida while maintaining nesting season requirements for the CSSS along with C&SF Project purposes. In order to achieve the action objective, USACE and FWS in conjunction with the multi-agency ERTP team, developed performance measures (PMs) and ecological targets (ETs) for each species and their habitat. PMs are defined as a set of operational rules that identify optimal WCA-3A water stages and recession rates to improve conditions in WCA-3A for snail kite, wood stork, wading birds and tree islands. In addition, PM-A addresses the nesting window for CSSS-A outlined in the 1999 FWS RPA. ETs are designed to support the intention of PMs. For example, ET-1 outlines a NP-205 stage of less than 7.0 feet NGVD by December 31. Based upon NP-205 recession rate calculations (FWS 2010c), a stage of less than 7.0 feet NGVD at NP-205 on December 31 will enable water levels to reach less than 6.0 feet NGVD by mid-March (PM-A). **Figure 2** shows the locations of the gauges specified within the ERTP PMs and ETs.

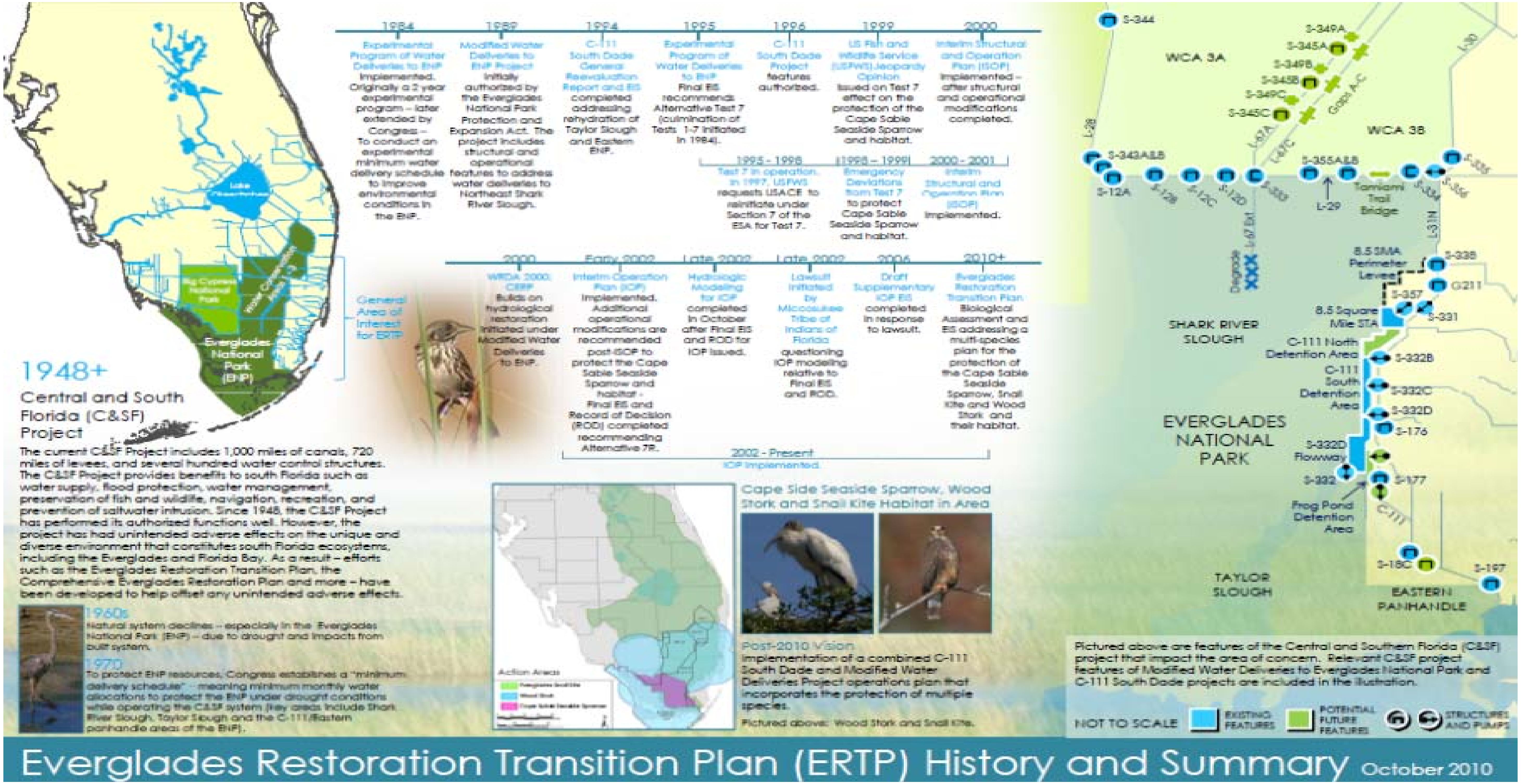


FIGURE 1: EVERGLADES RESTORATION TRANSITION PLAN

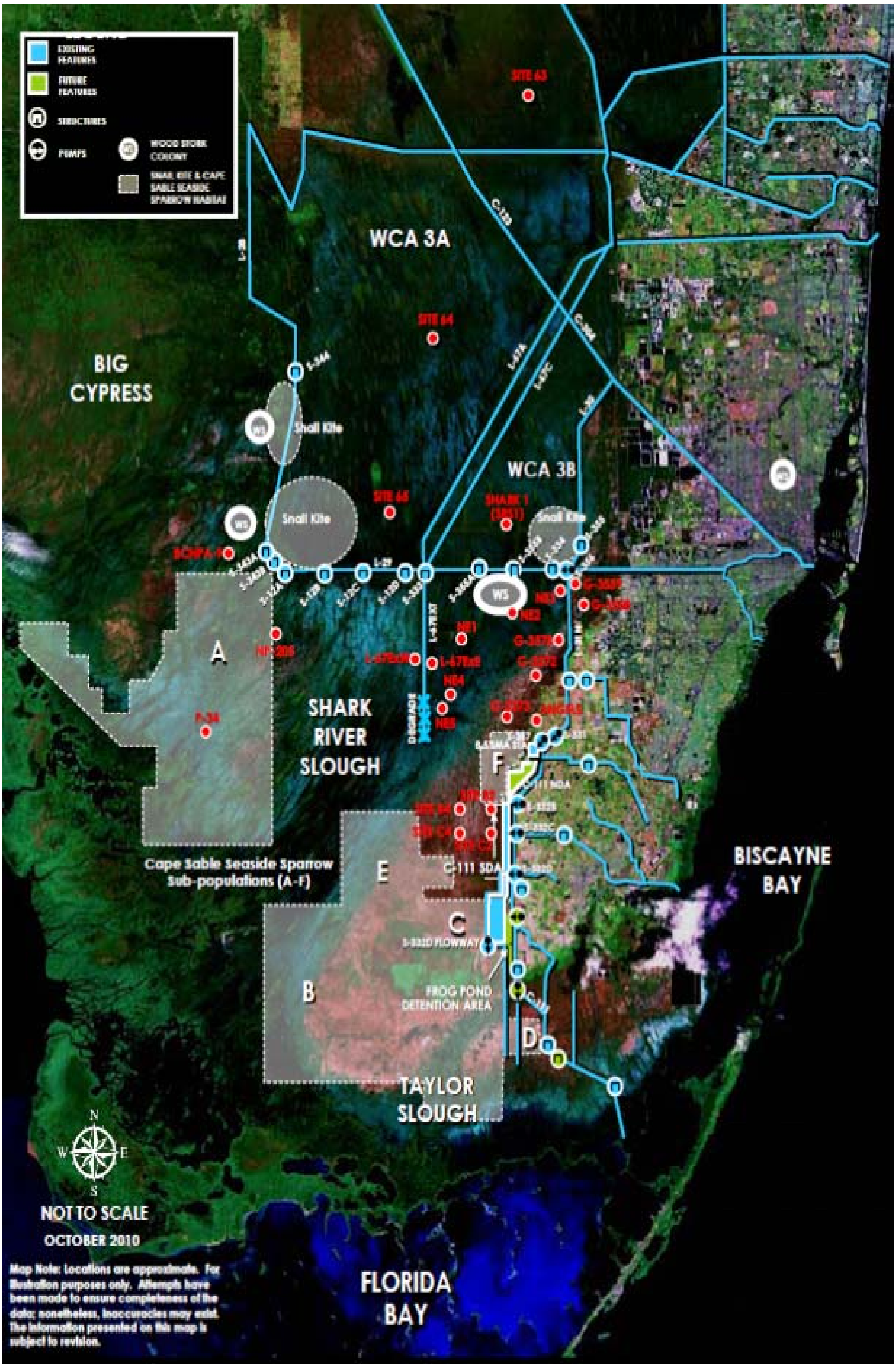


FIGURE 2: LOCATIONS OF GAUGES WITHIN ERTP ACTION AREA AS REFERENCED IN THE ERTP PERFORMANCE MEASURES AND ECOLOGICAL TARGETS

PERFORMANCE MEASURES

CAPE SABLE SEASIDE SPARROW

A. NP-205 (CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 15.

EVERGLADE SNAIL KITE/APPLE SNAIL

(Note: All stages for WCA-3A are as measured at WCA-3- gauge average [WCA-3AVG] [Sites 63, 64, 65])

B. WCA-3A: For snail kites, strive to reach water levels between 9.8 and 10.3 feet NGVD by December 31, and between 8.8 and 9.3 feet between May 1 and June 1.
C. WCA-3A: For apple snails, strive to reach water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet between May 1 and June 1.
D. WCA-3A (Dry Season Recession Rate): Strive to maintain a recession rate of 0.05 feet per week from January 1 to June 1 (or onset of the wet season). This equates to a stage difference of approximately 1.0 feet between January and the dry season low.
E. WCA-3A (Wet Season Rate of Rise): Manage for a monthly rate of rise less than or equal to 0 .25 feet per week to avoid drowning of apple snail egg clusters.

WOOD STORK/WADING BIRDS

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.
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.
H. WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the CFA (7 to 9 mile radius) of any active white ibis or snowy egret colony.

TREE ISLANDS

(Note: All stages for WCA-3A are as measured at WCA-3AVG [Sites 63, 64, 65])

I. WCA-3A: For tree islands, strive to keep high water peaks less than 10.8 feet NGVD, not to exceed 10.8 feet for more than 60 days per year, and reach water levels less than 10.3 feet NGVD by December 31.

ECOLOGICAL TARGETS

CAPE SABLE SEASIDE SPARROW

1. *NP-205 (CSSS-A): Strive to reach a water level of less than or equal to 7.0 feet NGVD at NP-205 by December 31 for nesting season water levels to reach 6.0 feet NGVD by mid-March.*
2. *CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation.*

EVERGLADE SNAIL KITE

3. *WCA-3A (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.*

3.4 ACTION LOCATION

The C&SF Project is located in south Florida and includes portions of several counties as well as portions of ENP, BCNP, and adjacent areas (**Figure 2**). ERTP defines water management operations for the constructed features of MWD and C-111 SD projects. The USACE June 1992 MWD GDM defines the project boundary as Shark River Slough and that portion of the C&SF Project north of S-331 to include WCA-3. The C-111 SD Project is situated within the C-111 basin which includes roughly 100 square miles of mostly agricultural lands in the Homestead/Florida City area. The C-111 SD Project adjoins ENP to the west, and discharges to Taylor Slough, the eastern panhandle of ENP, Florida Bay, Manatee Bay and Barnes Sound. The major project components of the MWD and C-111 SD Projects are shown in **Figure 3**. **Figure 4** defines the action area for CSSS, snail kite and wood stork, the three species for which USACE is requesting formal consultation under ESA.

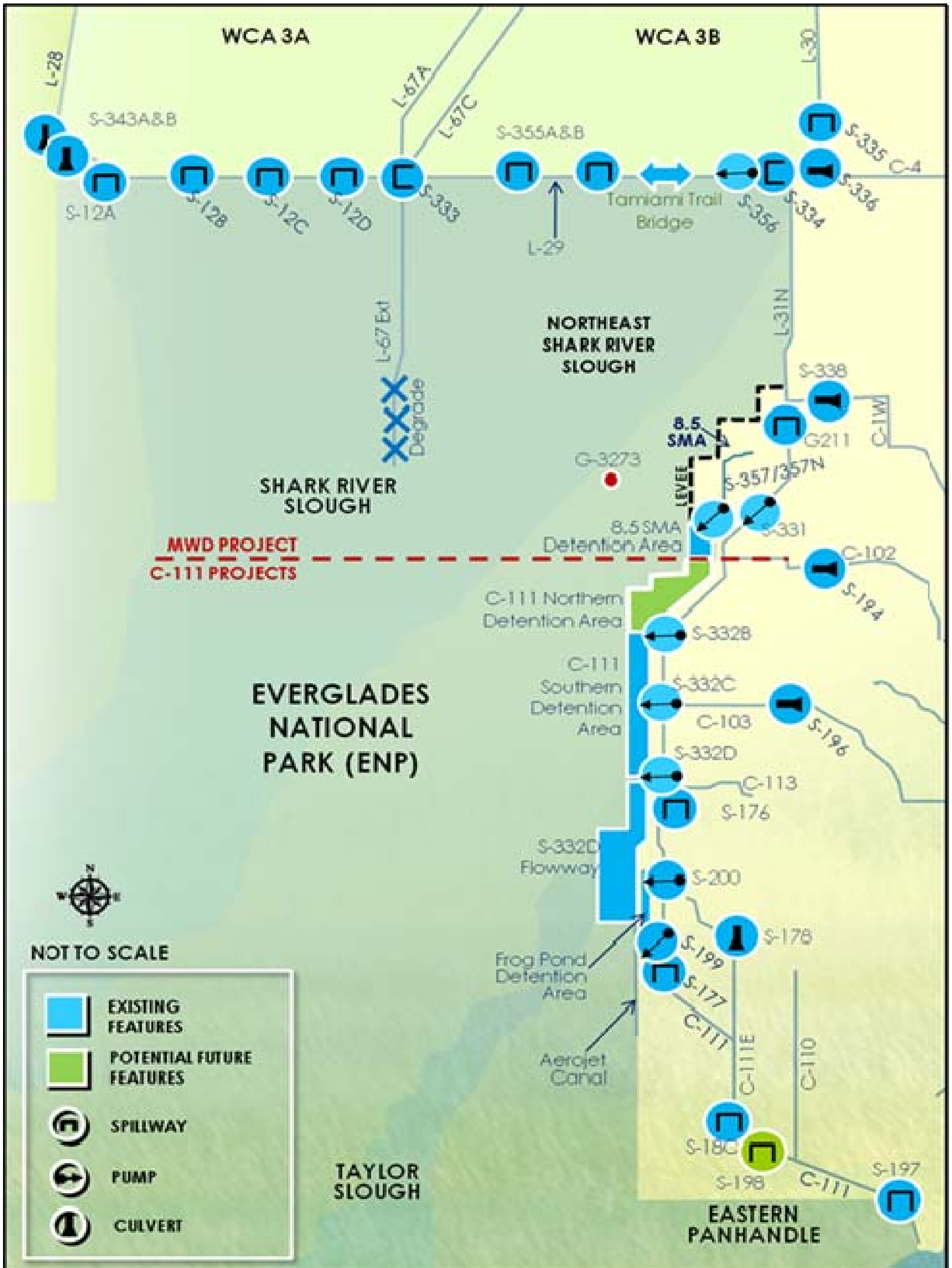


FIGURE 1-1. PROJECT LOCATION & RELEVANT C&SF PROJECT FEATURES OF THE MWD PROJECT & C-111 PROJECTS

FIGURE 3. PROJECT LOCATION AND RELEVANT C&SF PROJECT FEATURES OF THE MWD AND C-111SD PROJECTS

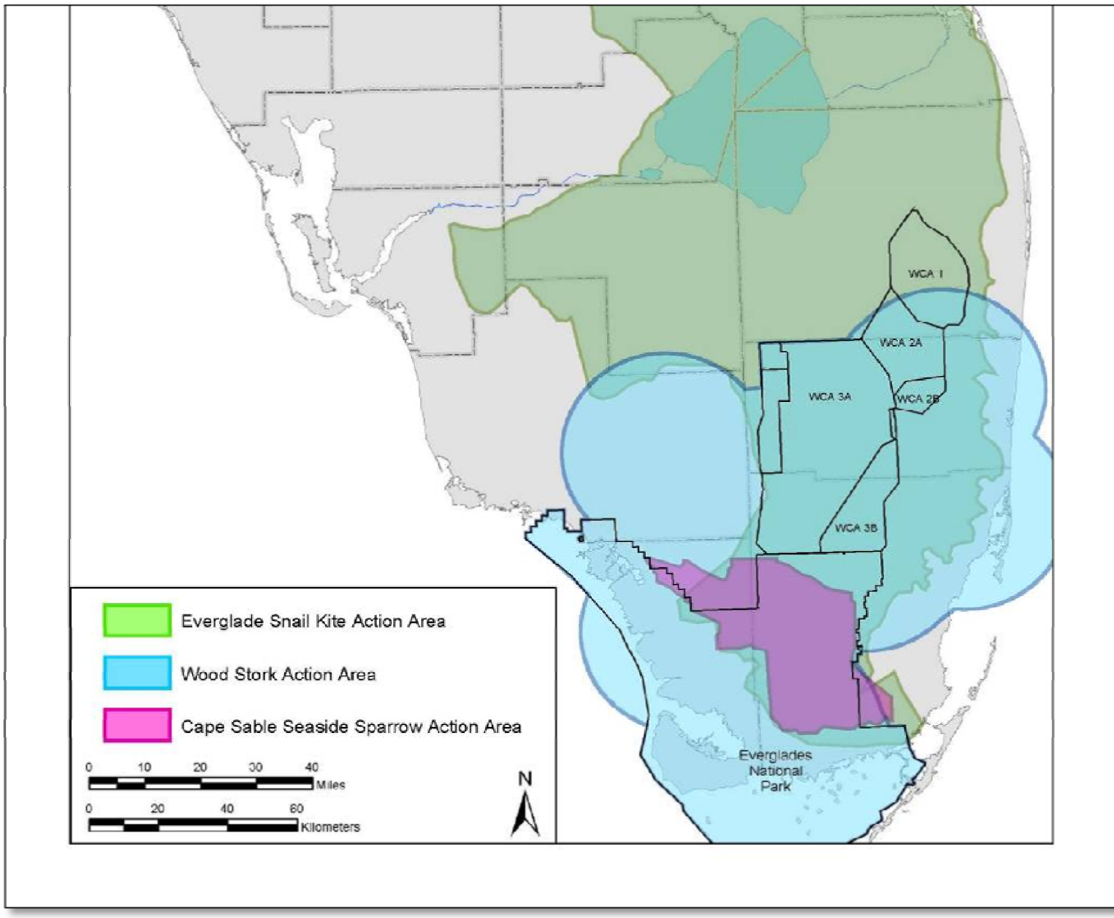


FIGURE 4. ERTP ACTION AREA

4 RECOMMENDED PLAN ELEMENTS

The ERTP recommended plan was chosen based upon hydrological modeling of system conditions using the South Florida Water Management Model (SFWMM). Within ERTP FEIS (USACE 2011), results of the modeling efforts were evaluated in relation to the ERTP PMs and ETs to select the alternative which best met the ERTP objectives, PMs and ETs. SFWMM Run 9E1 represents the ERTP Recommended Plan. Elements of ERTP include operational changes involving the IOP WCA-3A Regulation Schedule, S-12C, S-346 and S-332D structures, Rainfall Plan Target Flows and implementation of a WCA-3A PSC. A detailed description of ERTP recommended plan elements and an evaluation of potential effects on listed species is included within the October 15, 2010 ERTP Biological Assessment (**Appendix A**) and is hereby incorporated as reference. It is important to note that SFWMD received a FDEP permit in 2013 for permanent replacement of S-346 with a bridge to further facilitate flow. To further prevent westward flow of water into CSSS-A, the 2011 ERTP FEIS also included blocking of the Old Tamiami Trail Borrow Canal between S-12C and S-12B along blocking of culverts under the Shark Valley Tram Road (**Appendix H**). These last two items were to be implemented by DOI through ENP. To date, only the Shark Valley Tram Road culverts have been blocked.

Continued implementation of ERTP is the recommended plan within this Supplemental Biological Assessment. In addition to continued implementation of ERTP, USACE has identified five main reasonable and prudent measures under USACE authority that may act to further protect CSSS. USACE is committed to implementing these five main reasonable and prudent measures; therefore, water management operations for the next several years will include the following reasonable and prudent measures for protection of the endangered CSSS: 1) MWD Project Increment 1 Field Test; 2) implementation of operational flexibility within ERTP to protect CSSS; 3) a Water Flow Analysis Test; 4) MWD Increment 2 Field Test; and 5) Combined Operational Plan (i.e. MWD Increment 3). In addition, USACE will prepare an assessment, using an interagency team, of potential effects of Levee 28 (L-28) Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, USACE has not yet determined what authority might be required for such action. The MWD Project Increment 1 Field Test includes relaxation of Gauge 3273, a Term and Condition of the November 17, 2010 ERTP BO. As part of the MWD Project Increment 1 Field Test, USACE will conduct a spreadsheet tracking analysis to quantify how revised operations under MWD Increment 1 Field Test reduce flows through the S-12A, S-343A, S-343B, S-344 and S-12B structures.

4.1 MWD INCREMENT 1 FIELD TEST

The MWD Project Increment 1 Field Test, a deviation to ERTP, includes relaxation of Gauge 3273, a term and condition of the November 17, 2010 ERTP Biological Opinion. As part of the MWD Project Increment 1 Field Test, USACE will conduct a spreadsheet tracking analysis to quantify how revised operations under the Increment 1 Field Test reduce flows through the S-12A, S-343A, S-343B, S-344 and S-12B structures. Water management operations for approximately the next two years will be governed by MWD Project Increment 1 Field Test. The MWD Increment 1 Field Test will initiate when hydrologic conditions allow for relaxation of G-3273 above 6.8 feet NGVD consistent with MWD Increment 1 Field Test objectives, as early as August 2015.

The objectives of the MWD Increment 1 Field Test are defined below:

A. 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.

B. 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.

C. 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.

D. Gather and analyze infrastructure performance, ecologic, hydrologic and water quality data sufficient to support MWD Project Increment 2, resulting in the following:

i. Data gathering sufficient to support water quality certification
ii. Refined operational criteria for the MWD and C-111 South Dade Projects
iii. Updates to the 2012 Water Control Plan (i.e. ERTP)

Information obtained from Increment 1 is planned to be codified within the 2012 WCAs-ENP Water Control Plan (USACE 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 (USACE 2012c) to include COP (MWD Increment 3). Further information pertaining to 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 (*i.e.* MWD Increment 1 Field Test; **Appendix C**). This effort was extensively coordinated between May 2014 and June 2015 with FWS and a multi-agency team, consisting of Federal and State agencies, Federally-Recognized Tribes and the public.

In addition, throughout the MWD Increment 1 Field Test, USACE 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 reductions on S-333 operational constraints (*i.e.* 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 WCP. 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 Spreadsheet tracker was previously coordinated with FWS and approval on the methodology was received from FWS in a letter dated February 10, 2015 (Refer to **Appendix C**).

4.2 OPERATIONAL FLEXIBILITY WITHIN ERTP

The USACE will also employ operational flexibility within ERTP to include maximizing flows through S-12 structures from the east to the west as capacity allows. This flexibility will ensure that regulatory releases from WCA-3A are prioritized to the east to the extent practicable to reduce flows into western Shark River Slough where CSSS-A resides. In addition, when conditions allow, USACE will delay opening and/or implement early closure of S-12A, S-12B, S-343A/B and S-344 structures beyond their current restrictions to further limit flow into western Shark River Slough. In order to provide increased benefits to CSSS populations east of Shark River Slough, USACE will work in conjunction with FWS and our State sponsor, SFWMD, to alter the order of pumping at S-332B, S-332C and S-332D to meet CSSS needs when conditions allow (Appendix D). This flexibility will be used to promote an increased number of consecutive dry days within CSSS habitat as requested by FWS (90 or more consecutive dry days, March 3, 2015 FWS letter) to allow increased potential for breeding. In addition, this flexibility will be used to promote a 90-120 day discontinuous hydroperiod within CSSS habitat. Finally, ERTP 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 S-12 and S-333 structures. USACE 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 assist CSSS within the ERTP Action Area. The guidance is located in **Appendix D**.

As part of the informal consultation process following USACE reinitiation request of November 17, 2014, USACE provided an historical overview of flexibility in closure dates of S-12A, S-12B, S-343A, S-343B and S-344. As shown in **Figure 5**, during IOP/ERTP Water Year 2004 (May 1, 2003 through April 30, 2013) through Water Year 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. Thus, on average, the delayed S-12A and S-12B gate openings provided an additional 23-25 days without flow through these structures. USACE also provided a historical overview of S-12A and S-12B gate closure dates. As shown in **Figure 6**, in most years, S-12A closed November 1 as mandated by ERTP. However, there was variability in the closure date of S-12B structure. It is important to note that under ERTP, the S-12B structure mandated closure period for protection of CSSS is January 1 through July 14 annually. However, over the past twelve Water Years, S-12B closed as early as November 4 (Water Year 2007) and as late as January 1 (Water Year 2004), with an average closure date across all years of December 10. Therefore, in most years, early S-12B closures provided on average an additional 21 days without flow through S-12B (range of 1-58 additional days).

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. S-12 flows will be prioritized as follows. 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. If additional releases are still required and S-12D has reached its capacity, then S-12C will be utilized. If additional releases are still required and S-333, S-12D and S-12C are at capacity, then S-12B will be utilized for the required release. Finally, if additional releases are still required, 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 further reduced. It is important to note that releases through the S-12A and S-12B structures will only occur outside their mandated closure periods. Thus S-12B capacity will only be utilized between July 15 and December 31 and S-12A will only be utilized between July 15 and October 31.

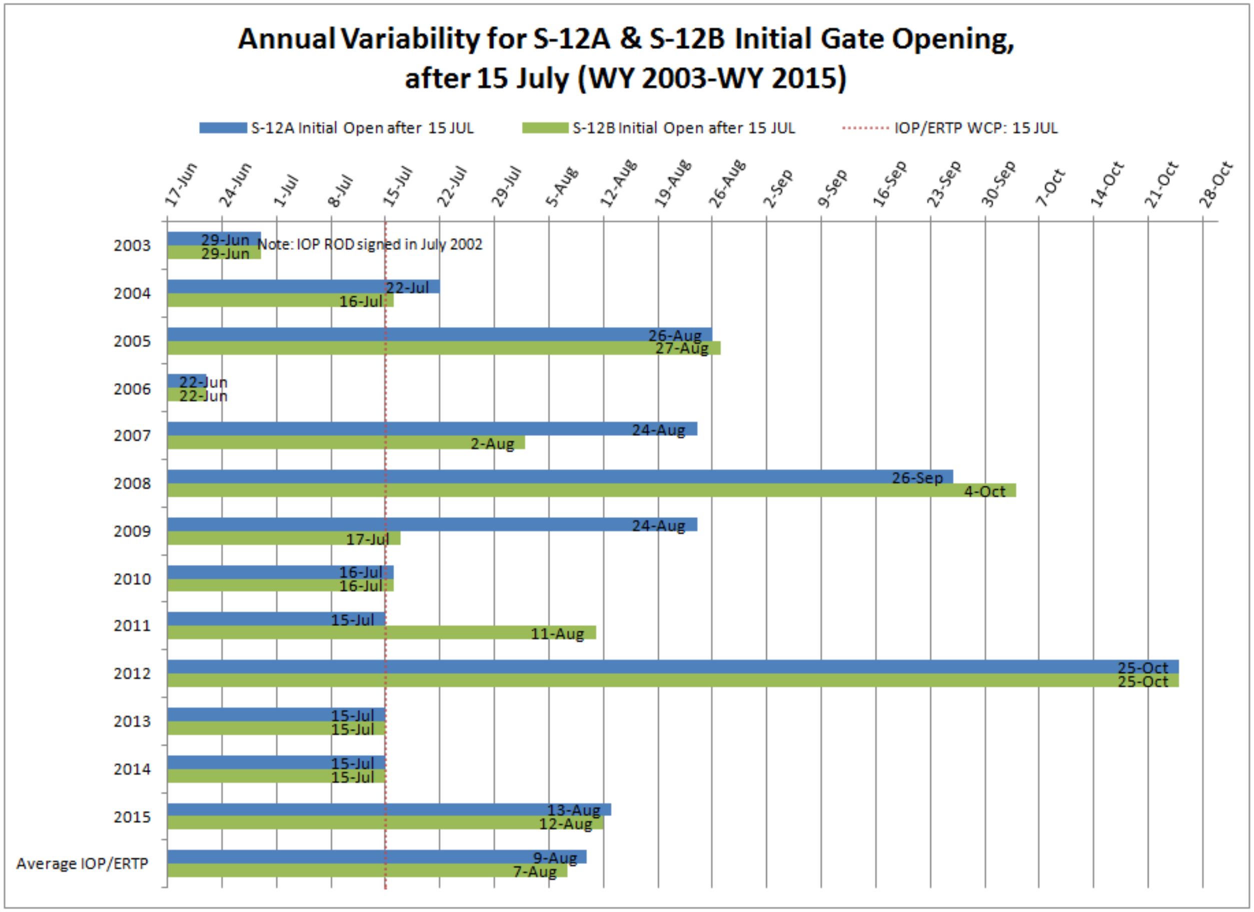


FIGURE 5. ANNUAL VARIABILITY FOR S-12A AND S-12B INITIAL GATE OPENING (WATER YEAR 2003-WATER YEAR 2015)

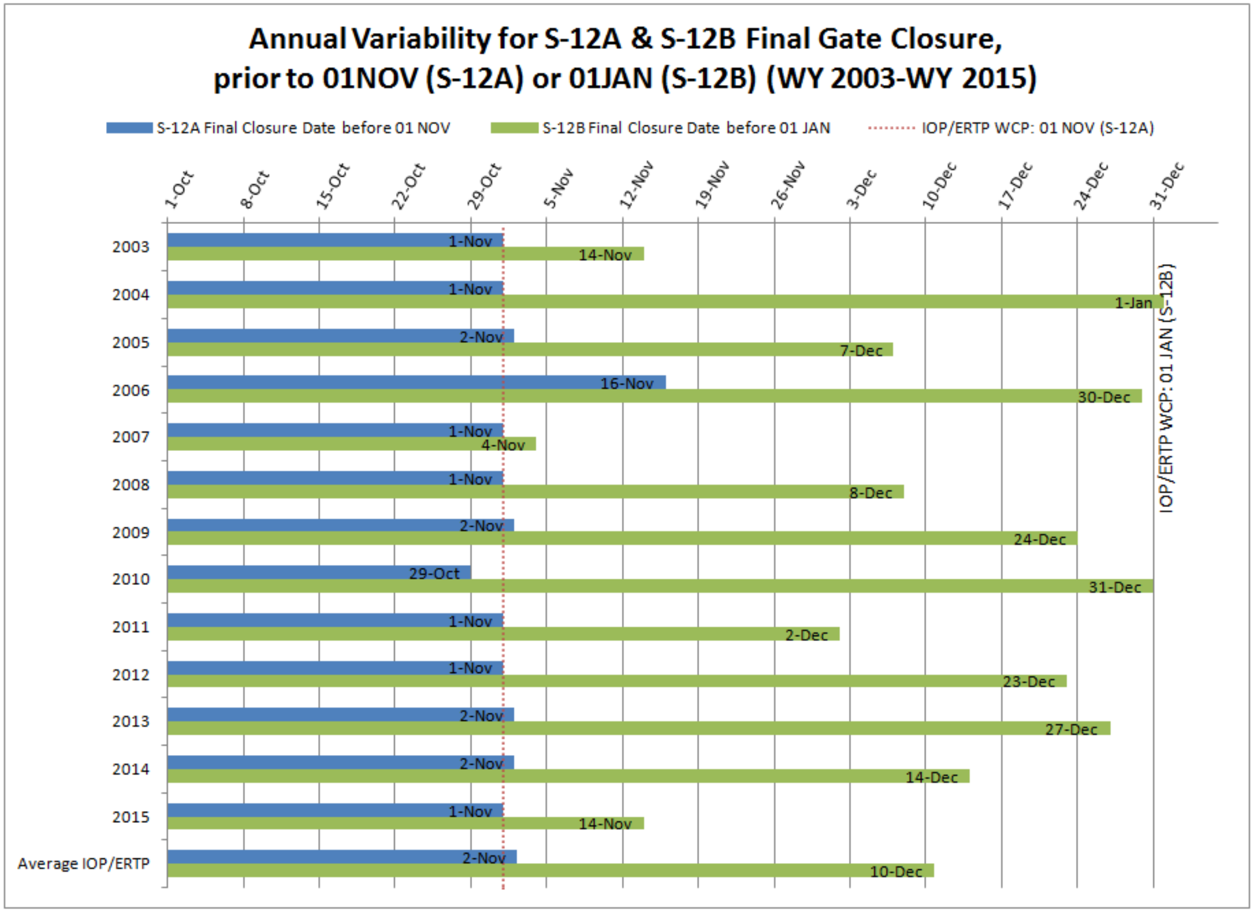


FIGURE 6. ANNUAL VARIABILITY FOR S-12A AND S-12B FINAL GATE CLOSURE (WATER YEAR 2003-WATER YEAR 2015)

4.3 WCA-3 INTERIM REGULATION SCHEDULE

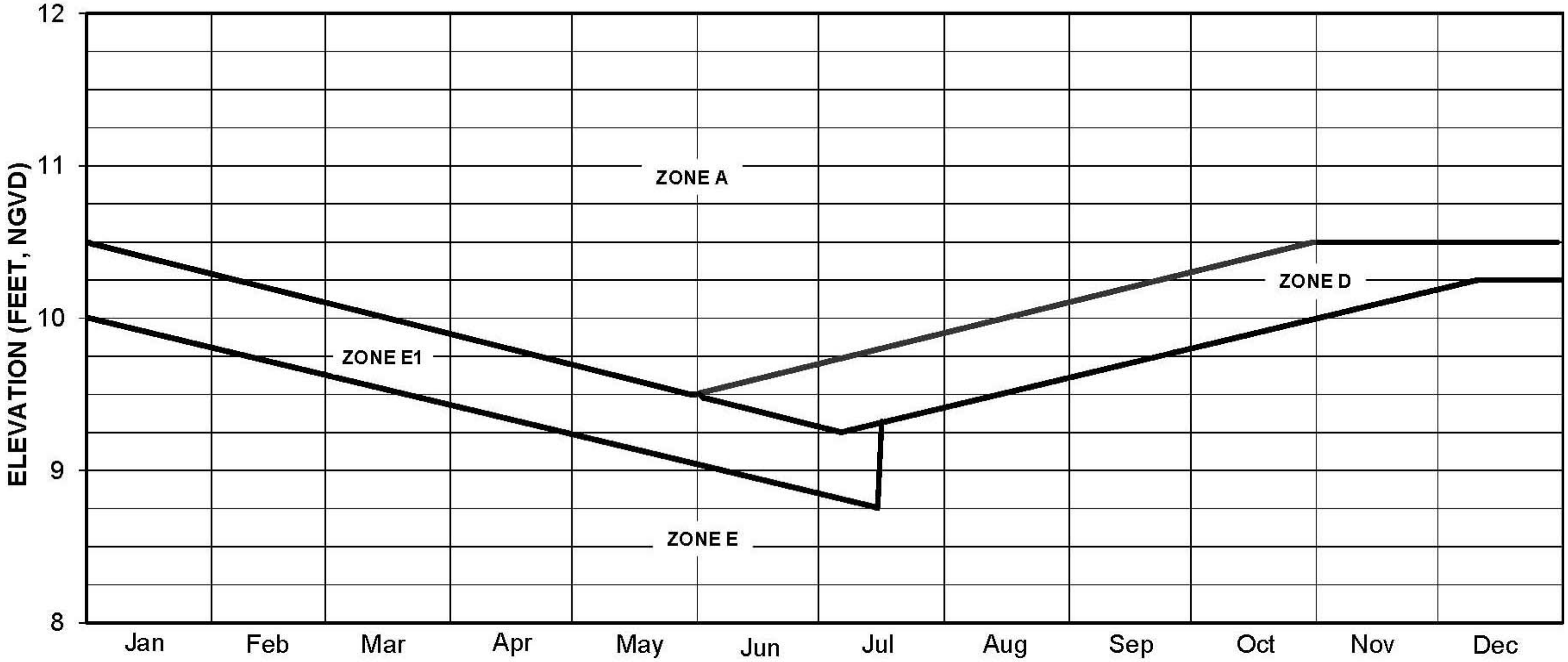
The ERTP WCA-3 Interim Regulation Schedule is shown in **Figure 7.** Revisions from IOP WCA-3 Regulation Schedule included incorporation of the WCA-3A 1960 9.5 to 10.5 feet NGVD Zone A, along with expansion of Zone D forward to December 31 and expansion of Zone E1 backwards to January 1. Similar to IOP WCA-3A Regulation Schedule, the ERTP regulation schedule utilizes the WCA-3A three-gauge average stage for operational management of WCA-3A. The intent of expanding Zones D and E1 is to achieve ERTP objectives of managing water levels within WCA-3A for the protection of multiple species and their habitats (ERTP PM B-I). Through this modification, USACE now has additional flexibility as compared with IOP WCA-3A Regulation Schedule in making water releases from WCA-3A in order to alleviate high water conditions in WCA-3A.

In July 2010, due to stakeholder concerns regarding high water levels in WCA-3A and discharge limitations of the S-12s, the USACE Jacksonville District Water Resources Engineering Branch conducted a review of the C&SF Part 1 Supplement 33 General Design Memorandum (GDM) for (June 1960) and the C&SF Part 1 Supplement 49: Agricultural and Conservation Areas General and Detail Design Memorandum (August 1972). Based upon the results of their review, USACE concluded that a rigorous evaluation of the Standard Project Flood (SPF) conditions within WCA-3A is needed to consider changed operational parameters as compared to the original design assumptions (USACE 2010). USACE proposed a two-phase analysis approach that included the identification and assessment of interim water management criteria for WCA-3A, including operational changes proposed 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 spillways, 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. The Phase 2 WCA-3A flood routing analysis, which includes the Baseline and Modification Model, or BAMM, is currently underway. 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 original 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 USACE to conduct comprehensive risk analysis of levees and structures within the WCAs, including hydraulic and hydrological, geotechnical and structural engineering disciplines, if results warrant. The USACE 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 would be used with other regional hydrologic modeling tools to evaluate mitigation options, if necessary. The current expected completion date for the BAMM is September 2017. Until the results of the BAMM are available, including further analysis and quantification of risk to WCA levees and structures, USACE is not proposing any changes to the WCA-3A Regulation schedule within this

Supplemental Biological Assessment. In addition, USACE is not proposing any changes to the mandated closure periods for the S-12A, S-12B, S-343A, S-343B or S-344 structures within this Supplemental Biological Assessment due to the potential effects of additional closure periods on water elevations within WCA-3A. Please refer to the 2010 ERTP Biological Assessment (**Appendix A**) for a full evaluation of potential effects of WCA-3A Interim Regulation Schedule on listed species within the ERTP Action Area.

4.4 S-12, S-343, S-344 AND S-346 STRUCTURES

Seasonal closure periods of the S-12A, S-12B, S-343A, S-343B and S-344 structures for protection of CSSS will be maintained under continued implementation of ERTP and throughout MWD Increment 1 Field Test. At the request of FWS, USACE evaluated four additional closure criteria as described within **Table 1**. However, based upon WCA-3A high water concerns identified within ERTP FEIS, as well as the fact that BAMM has not yet been completed, USACE is 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, USACE is committed to implement operational flexibility as described in Section 4.2 in order to reduce flows through these structures as conditions permit.



Notes: Zones B and C do not exist. Use 3-gage average elevation (Sites 63, 64, and 65). If 3-gage average is in Zone D from 1 June through 14 July, Zone E1 operating criteria may be utilized.

Zone A: Up to maximum releases at S-12A, S-12B, S-12C, S-12D, S-333, S-334, S-343A, S-343B, S-344, and S-151 subject to attached Part C and WCA-3A, ENP, and ENP-SDCS Water Control Plan.

Zones D, E: Goal is to release 45% and 55% at S-12s and S-333, respectively, of the computed flow for Shark River Slough, subject to attached Part C and WCA-3A, ENP, and ENP-SDCS Water Control Plan.

Zone E1: Up to maximum releases at S-12C, S-12D, S-142, S-151, S-31, S-337, S-335, S-333, S-355A, S-355B and S-334 subject to attached Part C and WCA-3A, ENP, and ENP-SDCS Water Control Plan. The goal of Zone E1 is to address the reduction of WCA-3A releases due to CSSS-A structure closure periods.

CENTRAL AND SOUTHERN FLORIDA PROJECT

WATER CONSERVATION AREA NO. 3A INTERIM REGULATION SCHEDULE

PART A

DATED: March 2012
US ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA

FIGURE 7: ERTP WATER CONSERVATION AREA 3A INTERIM REGULATION SCHEDULE

4.5 S-332-B, S-332C AND S-332D OPERATIONS

The 1994 C-111 SD Project GRR authorized construction of a series of pump stations and detention areas along the eastern boundary of ENP. This detention system was constructed to maintain a hydrologic ridge between ENP and the developed portions of Miami-Dade County to the east thereby reducing seepage from ENP and rehydrating the marshes along the ENP boundary. Prior to construction of C-111 SD Project, water was delivered to Taylor Slough by releasing water through S-174. Subsequently this water was lifted from L-31W Canal into Taylor Slough via S-332 pump station. The S-332 pump station had a maximum capacity of approximately 165 cubic feet per second (cfs).

The S-332D pump station and S-332D Detention Area (aka S-332D Flowway) were constructed under ISOP and IOP and are located along the west side of C-111 Canal between S-176 and S-177 (**Figure 3**). The S-332D pump station became operational on August 31, 1999 and S-332D Detention Area became operational in June 2002. The S-332D structure discharges to a downstream high head cell and detention area flowway, ultimately delivering surface water flows into Taylor Slough near the historical location of S-332.

Under the Experimental Program, the pump capacity of S-332 was increased by approximately 300 cfs, thereby allowing approximately 465 cfs to be directly delivered to Taylor Slough. The 1999 FWS Jeopardy Opinion on CSSS occurred during the Experimental Program and resulted in termination of the testing phase. The amount of water that could be delivered to Taylor Slough without impacting CSSS, subpopulation C (CSSS-C) was never evaluated under the Experimental Program. The 465 cfs was thought to have an impact on CSSS-C while the original 165 cfs was not thought to have an impact (1999 FWS BO). In order to err on the side of conservatism to protect the species, the original S-332 pump capacity of 165 cfs was implemented under IOP during CSSS breeding season. As a result, pumping at S-332D is limited to 165 cfs from February 1 through July 15 in order to maintain nesting season requirements for CSSS-C. The 2006 IOP FSEIS Table ES-1 includes the statement that information would be sought to evaluate the feasibility of modifying this constraint.

Field data from the Experimental Program and data from 2008 and 2009 revealed that a significant volume of water pumped into S-332D flows as seepage to the C-111 Canal. Limiting S-332D discharges to 165 cfs results in considerably less water reaching Taylor Slough than when S-174 and S-332 were used. As a result, under ERTP pumping at S-332D was increased from 165 cfs to 250 cfs between February 1 and July 16 (or the end of the CSSS nesting season as determined by FWS).

In a letter dated December 12, 2014, FWS provided an assessment of operations within the C-111SD Project area to include detention cells and project components of the CERP C-111 Spreader Canal Western Project. It is important to note that operations of the CERP C-111 Spreader Canal Western Project are currently under the sole operation of SFWMD under an FDEP and USACE Regulatory Permit. Operations of the CERP C-111 Spreader Canal Western Project are governed by a separate ESA consultation and FWS BO. In addition, any adjustments to the operation of the CERP C-111 Spreader Canal Western Project may require modifications to existing permits. Finally, USACE 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. The order of S-332B, S-332C and S-332D pumping will be prioritized base on coordination with the FWS, SFWMD and ENP. Local rainfall patterns, antecedent conditions and operations will be discussed in real-time to determine pumping prioritization. Until completion of construction of the C-111 SD Project components (e.g. Northern Detention Area and connection to MWD 8.5 SMA detention cell) is complete, USACE is not proposing any operational changes outside the existing ERTP flexibility.

4.6 PREEMPTIVE RELEASES

ERTP 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. 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 S-12 and S-333 structures to create storage within WCA-3A. 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. 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.

4.7 RAINFALL PLAN TARGET FLOWS

Releases through the S-333 and S-12 structures are part of the WCA-3A Regulation Schedule and are determined by the Rainfall Plan. Under the Rainfall Plan, WCA-3A water release targets to ENP are computed and operations adjusted weekly based on the sum of two components: a rainfall response component and a WCA-3A regulatory component. Currently, the normal target flow distribution is 55% through the S-333 into NESRS and 45% through the S-12 structures into ENP west of the L-67 Extension. Under ERTP, releases through the S-333 are constrained by the trigger stage at G-3273, which is 6.8 feet NGVD under the 2006 IOP, and the L-29 Canal maximum operating limit of 7.5 feet NGVD. Therefore, when G-3273 is less than 6.8 feet NGVD, 55% of the Rainfall Plan Target Flow is released into NESRS. USACE also gathers input from ENP in regard to the distribution of rainfall plan flows to ENP. However, when G-3273 is greater than 6.8 feet NGVD, S-334 is used to pass all or partial S-333 flows through the SDCS. When S-333 is closed and partial flows cannot be passed through S-334, the volume of flow that could not be delivered at S-333 shifts to the S-12 structures. In this manner, the G-3273 trigger stage limits the volume of water entering NESRS. However, the MWD Increment 1 Field Test will reduce the G-3273 constraint, thereby reducing a constraint on S-333 flow, allowing additional flow into NESRS. The existing Rainfall Plan within the current Water Control Plan (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 (**Appendix A**, **Annex A**). However, due to the implementation of the USACE Interim High Water Criteria for WCA-3A which lowers Zone A of the current WCA-3A Regulation Schedule, S-333 target flows for non-regulatory releases during the dry season (November 1 through June 1) will be increased from 55% to 80%. This increase will help to maintain dry season flows into NESRS that would have been reduced as a result of lowering the WCA-3A Regulation Schedule.

4.8 WATER CONSERVATION AREA 3 PERIODIC SCIENTISTS CALL

The purpose of WCA-3 PSC is for USACE to gather scientific input regarding ecological, hydrological and meteorological conditions from various Tribal and governmental agencies to make future water management decisions. The monitoring and reporting of ecological, hydrological, meteorological and multiple species conditions is critical to achieving the ERTP objective of managing WCA-3A water levels and releases for the protection of multiple species and their habitats. Regularly scheduled calls in January, May and October will allow USACE to gather input on desired long-term (annual and/or seasonal) conditions within WCA-3A and ENP. In addition, WCA-3 PSC will occur on an as-needed basis and the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS and ENP. Continued implementation of WCA-3 PSC will allow for adaptive management of the system based upon the needs of multiple species and their habitats. As well, USACE and FWS, along with other interested agencies, will meet annually to discuss species monitoring data in order to ensure that the species monitoring is capturing the appropriate parameters and, over time, to identify any long-term population trends. USACE will continue to implement WCA-3 PSC throughout MWD Increment 1 Field Test providing real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process.

4.9 WATER FLOW ANALYSIS TEST

The USACE is also planning to implement a Water Flow Analysis Test in order to identify the source 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, **Figure 8**), 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 reasonable and prudent 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.

Potential effects from western flows (from eastern BCNP, west of WCA-3A L-28 Levee) on CSSS-A were analyzed by USACE during CSOP ESA coordination with FWS during 2006-2007, including presentations to the 2007 Avian Ecology Workshop. The potential for western flows to influence hydrology within CSSS-A core habitat areas were also discussed during ERTP. Due to regional topographic gradients, when WCA-3A is high, water from western WCA-3A flows south through gaps previously constructed in 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 40-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 (**Figure 8**). 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 (**Figure 9**). Vegetation mapping also indicated a transition from prairie-marsh to marsh vegetation as more prevalent 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. FWS personnel at a March 26, 2015 meeting referenced that CSSS experienced crashes in the early 1980s and 1990s, relaying that there may be a possible connection. However, at the same meeting, USACE personnel noted that the 1970s and 1980s were overall drier years in the climatic cycle compared to the 1990s.

Since a Water Flow Analysis test was first discussed during the course of informal consultation, USACE has 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 this analysis. The current thought process is 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. If the interagency efforts to further define the scope of work concur with the initial approach to conduct the test under two hydrologic flow regimes, the results from the first test may be used to identify areas for more refined and intensive monitoring.

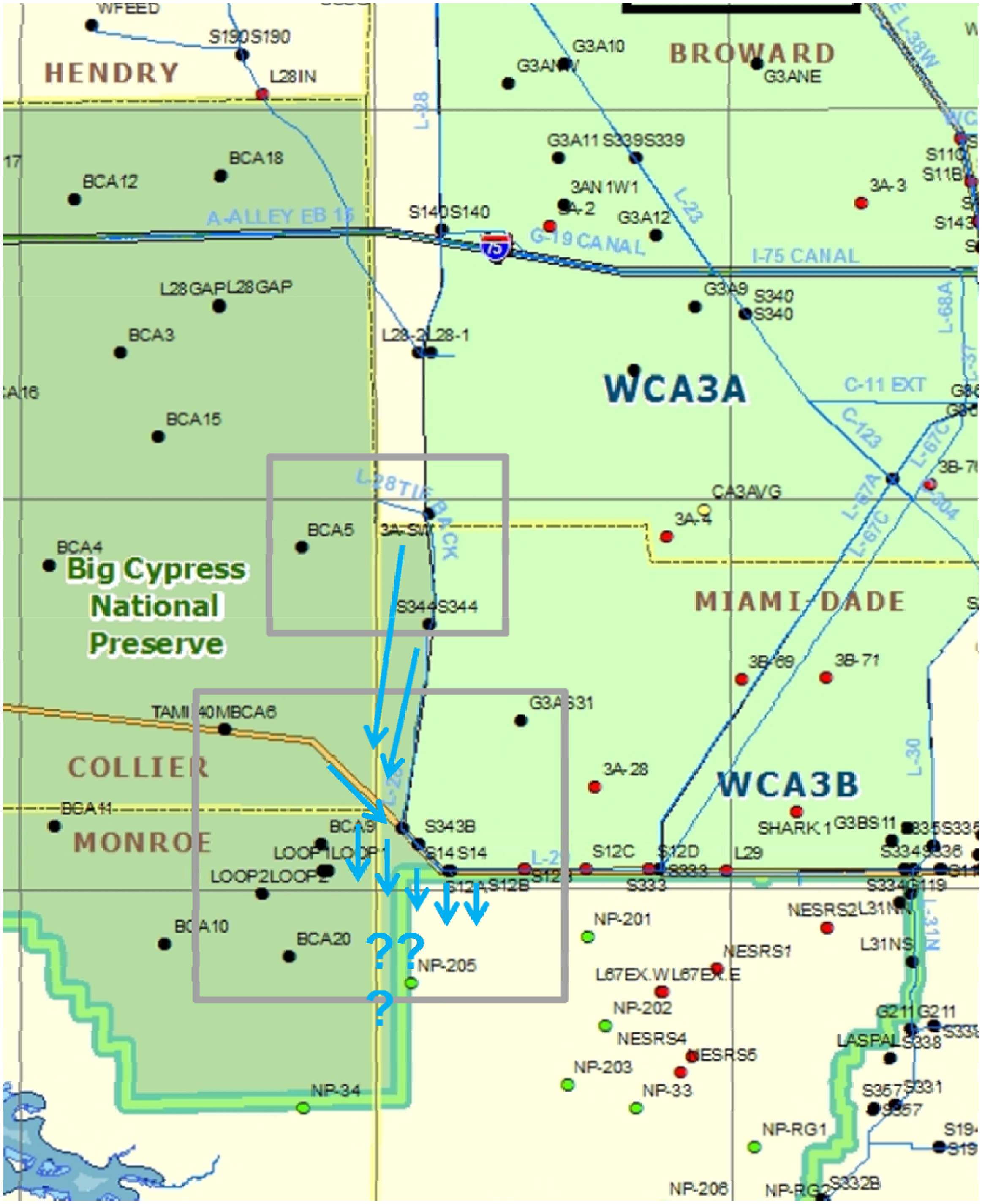
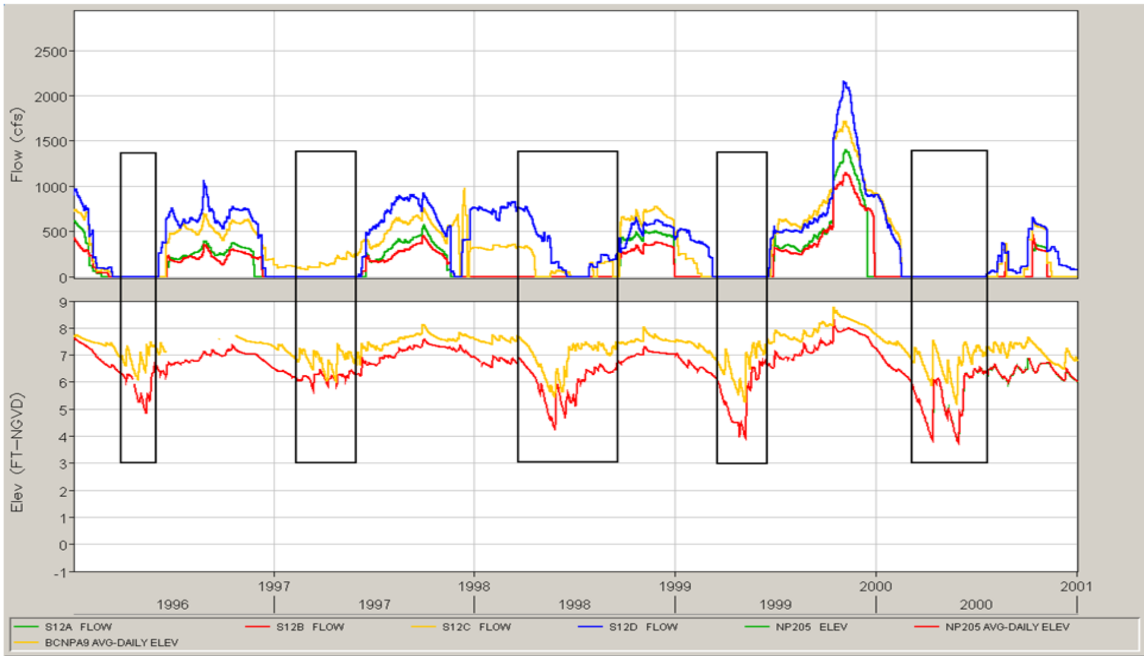


FIGURE 8. AREA OF FOCUS FOR WATER FLOW ANALYSIS TEST: L-28 LEVEE; TAMIAMI TRAIL 40-MILE AND 50-MILE BEND



Flow: S-12A; S-12B; S-12C; S-12D Gauge: BCNP A-9; NP-205

FIGURE 9. COMPARISON OF STRUCTURE FLOW AND STAGES AT GAUGE NP-205 AND BCN A- 9 BETWEEN 1996 AND 2001

4.10 MWD INCREMENT 2

MWD Increment 2 Test will be the second field test to transition the environment within ERTP action area. Information and operational criteria identified from 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 (USACE 1992). Other operational changes to structures within the 2012 WCAs-ENP-SDCS Water Control Plan (USACE 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. Operational changes based on MWD Increment 1 Field Test are planned to be incorporated into the 2012 WCAs-ENP-SDCS Water Control Plan (USACE 2012) prior to implementing the operational strategy for MWD Increment 2 Field Test as appropriate. Implementation of a multiagency team planning effort is currently scheduled to commence in April 2016 (**Appendix E**). This effort will require additional NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of COP within this Supplemental Biological Assessment.

4.11 COMBINED OPERATIONAL PLAN (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 (USACE 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 is scheduled to be initiated in September 2015 with implementation of a multiagency team planning effort currently scheduled to commence in July 2017 in order to include data obtained through MWD Increment 1 and Increment 2 Field Tests (**Appendix E**). This effort will require additional NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of COP within this Supplemental Biological Assessment.

4.12 L-28 BORROW CANAL

The USACE will prepare an assessment, using an interagency team, of potential effects of L-28 Borrow Canal flows into western CSSS-A habitat (**Figure 10**). Results from this assessment could be used to recommend further action; however, USACE 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 multiagency team to include FWS, 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. This effort will require authorization, NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of L-28 Borrow Canal options within this Supplemental Biological Assessment.

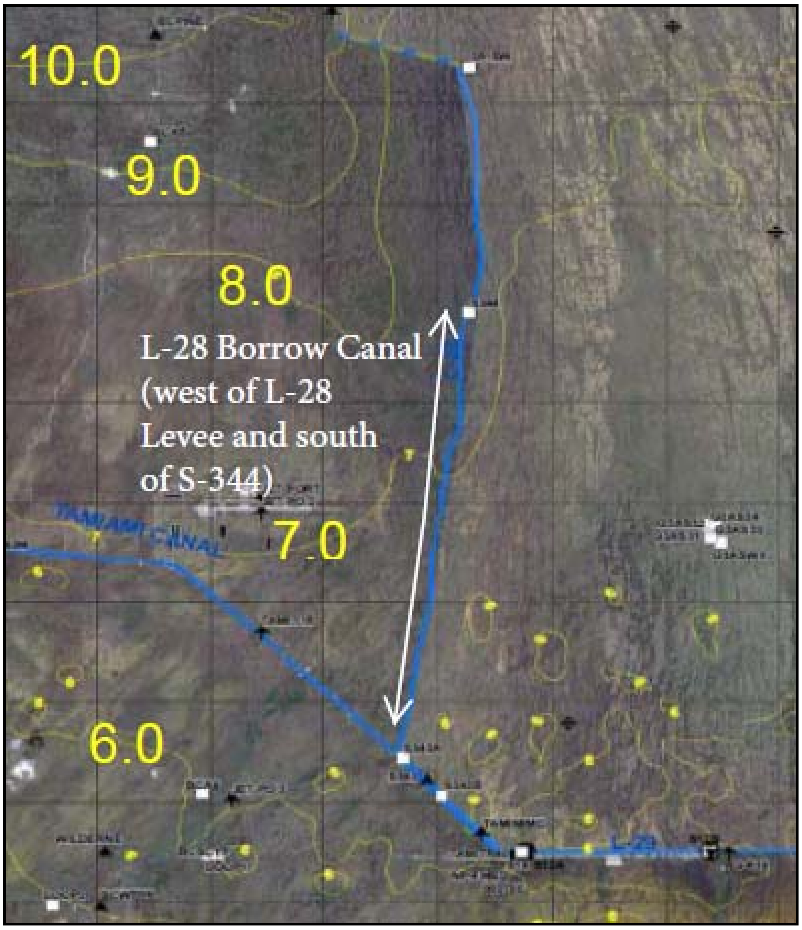


FIGURE 10. LOCATION OF L-28 BORROW CANAL

5 DESCRIPTION OF LISTED SPECIES AND DESIGNATED CRITICAL HABITAT

5.1 AFFECTED ENVIRONMENT

The action area includes NESRS, Western Shark River Slough, WCA-1, WCA-2 and WCA-3, Taylor Slough, Lower East Coast area, 8.5 SMA and Biscayne and Florida Bays. The 2012 ERTP FEIS provides a full description of the affected environment within the action area and is incorporated into this document by reference. This information is available for review at: http://141.232.10.32/pm/program_docs/ertp.aspx

5.1.1. VEGETATIVE COMMUNITIES

The Everglades landscape is dominated by a complex of freshwater wetland communities that includes open water sloughs and marshes, dense grass- and sedge-dominated marshes, forested islands, and wet marl prairies. The primary factors influencing the distribution of dominant freshwater wetland plant species of the Everglades are soil type, soil depth, and hydrological regime (FWS 1999). These communities generally occur along a hydrological gradient with the slough/open water marsh communities occupying the wettest areas (flooded more than nine months per year), followed by sawgrass marshes (flooded six to nine months per year), and wet marl prairie communities (flooded less than six months per year) (FWS 1999). The freshwater wetlands of the Everglades eventually grade into intertidal mangrove wetlands and subtidal seagrass beds in the estuarine waters of Florida Bay.

Development and drainage over the last century have dramatically reduced the overall spatial extent of freshwater wetlands within the Everglades, with approximately half of the pre-drainage 1.2 million hectares of wetlands being converted for development and agriculture (Davis and Ogden 1997). Alteration of the normal flow of freshwater through the Everglades has also contributed to conversions between community types, invasion by exotic species, and a general loss of community diversity and heterogeneity. Vegetative trends in ENP have included a substantial shift from the longer hydroperiod slough/open water marsh communities to shorter hydroperiod sawgrass marshes (Davis and Ogden 1997; Armentano et al. 2006). In addition, invasion of sawgrass marshes and wet prairies by exotic woody species has led to the conversion of some marsh communities to forested wetlands (Gunderson 1997).

Vegetative communities of the WCAs have suffered from both over drainage and prolonged periods of inundation associated with the stabilization of water levels (USACE 1999a). Increased flooding and water depths in WCA-2A have resulted in the loss of wet prairie communities, drowning of tree islands, and loss of sawgrass marshes along slough edges. Major plant communities of WCA-2A now consist of remnant (drowned) tree islands, open water sloughs, and large expanses of sawgrass and sawgrass-cattail marshes. The increase in cattails in WCA-2A is attributed to increased nutrient loading associated with agricultural runoff. WCA-2B has suffered from lowered water levels resulting in heavy melaleuca (*Melaleuca quinquenervia*) infestations throughout the area. Increased deliveries of water to WCA-2B associated with drawdowns of WCA-2A in the 1980s has helped somewhat to slow the advance of melaleuca.

Many areas of WCA-3A still contain relatively good wetland habitat consisting of a complex of tree islands, sawgrass marshes, wet prairies, and aquatic sloughs. Water lilies (*Nymphaea alba*) were originally widespread in sloughs throughout many areas of WCA-3A (McVoy et al. 2011). Reduced freshwater inflow and drainage by the Miami Canal have overdrained the northern portion of WCA-3A, resulting in increased fire frequency and the associated loss of tree islands, wet prairie and aquatic slough habitat. Northern WCA-3A is currently dominated largely by mono-specific sawgrass stands with large areas of shrubs and monotypic cattail. In addition, northern WCA-3A lacks the diversity of communities that exists in southern WCA-3A. In southern WCA-3A, Wood and Tanner (1990) documented the trend toward deep water lily dominated sloughs due to impoundment. In approximately 1991, the hydrology of southern WCA-3A shifted to the deeper water and extended hydroperiods of the new, wet hydrologic era resulting in a northward shift in slough vegetation communities within the WCA-3A impoundment (Zweig and Kitchens 2008). Typical Everglades vegetation, including tree islands, wet prairies, sawgrass marshes and aquatic sloughs also occur throughout WCA-3B. However, within WCA-3B, the ridge and slough landscape has been severely degraded by the virtual elimination of overland sheetflow due to the L-67 canal and levee system. WCA-3B experiences very little overland flow and has become primarily a rain-fed system predominated by shorter hydroperiod sawgrass marshes with relatively few sloughs or tree islands remaining. Water levels in WCA-3B are also too low and do not vary seasonally, contributing to poor ridge and slough patterning. Loss of sheetflow to WCA-3B has also accelerated soil loss reducing elevations of the remaining tree islands in WCA-3B and making them vulnerable to high water stages.

Vegetative trends in ENP have included a substantial shift from the longer hydroperiod slough/open water marsh communities to shorter hydroperiod sawgrass marshes (Davis and Ogden 1997, Armentano et al. 2006). Flows through Shark River Slough under current system compartmentalization and water management practices are greatly reduced when compared with pre-drainage conditions. The result has been lower wet season depths and more frequent and severe dry downs in sloughs and reduction in extent of shallow water edges (McVoy et al. 2011). Over-drainage in the peripheral wetlands along the eastern flank of (NESRS) has resulted in shifts in community composition, invasion by exotic woody species and increased susceptibility to fire. Areas within the eastern marl prairies along the boundary of ENP suffer from over-drainage, reduced water flow, exotic tree invasion and frequent human-induced fires (Lockwood et al. 2003; Ross et al. 2006). In addition, invasion of sawgrass marshes and wet prairies by exotic woody species has led to the conversion of some marsh communities to forested wetlands (Gunderson et al. 1997).

The estuarine communities of Florida Bay have also been affected by upstream changes in freshwater flows through the Everglades. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance have affected mangrove community composition and may have contributed to a large-scale die-off of seagrass beds (FWS 1999).

In contrast to the vast extent of wetland communities, upland communities comprise a relatively small component of the Everglades landscape and are largely restricted to Long Pine Key, the northern shores of Florida Bay, and the many tree islands scattered throughout the region. Vegetative communities of Long Pine Key include rockland pine forest and tropical hardwood forest. In addition, substantial areas of tropical hardwood hammock occur along the northern shores of Florida Bay and on elevated portions of some forested islands.

5.1.2. SLOUGH/OPEN WATER MARSH

The slough/open water marsh community occurs in the lowest, wettest areas of the Everglades. This community is a complex of open water marshes containing emergent, floating aquatic, and submerged aquatic vegetation components. The emergent marsh vegetation is typically dominated by spikerushes (*Eleocharis cellulosa* and *E. elongata*), beakrushes (*Rhynchospora tracyi* and *R. inundata*), and maidencane (*Panicum hemitomon*). Common floating aquatic dominants include fragrant water lily (*Nymphaea odorata*), floating hearts (*Nymphoides aquatica*), and spatterdock (*Nuphar lutea*); and the submerged aquatic community is typically dominated by bladderwort (*Utricularia foliosa*) and periphyton. As shown by Davis et al. (1997), vegetative trends in the ENP have included the conversion of slough/open water marsh communities to shorter hydroperiod sawgrass marshes.

5.1.3. SAWGRASS MARSH

Sawgrass marshes are dominated by dense to sparse stands of *Cladium jamaicense*. Sawgrass marshes occurring on deep organic soils (more than one meter) form tall, dense, nearly monospecific stands. Sawgrass marshes occurring on shallow organic soils (less than one meter) form sparse, short stands that contain additional herbaceous species such as spikerush, water hyssop (*Bacopa caroliniana*), and marsh mermaid weed (*Proserpinaca palustris*) (Gunderson et al. 1997). The adaptations of sawgrass to flooding, burning, and oligotrophic conditions contribute to its dominance of the Everglades vegetation. Sawgrass-dominated marshes once covered an estimated 300,000 acres of the Everglades. Approximately 70,000 acres of tall, monospecific sawgrass marshes have been converted to agriculture in the EAA. Urban encroachment from the east and development within other portions of the Everglades has consumed an additional 79,000 acres of sawgrass-dominated communities (Davis and Ogden 1997).

5.1.4. WET MARL PRAIRIE

Wet marl prairies occur on marl soils and exposed limestone and experience the shortest hydroperiods of the slough/marsh/prairie wetland complex. Marl prairie is a sparsely vegetated community that is typically dominated by muhly grass (*Muhlenbergia capillaris*) and short-stature sawgrass. Additional important constituents include black sedge (*Schoenus nigricans*), arrowfeather (*Aristida purpurascens*), Florida little bluestem (*Schizachyrium rhizomatum*), and Elliot's lovegrass (*Eragrostis elliottii*). Periphyton mats that grow loosely attached to the vegetation and exposed limestone also form an important component of this community. Marl prairies occur in the southern Everglades along the eastern and western periphery of SRS. Approximately 146,000 acres of the eastern marl prairie have been lost to urban and agricultural encroachment (Davis and Ogden 1997). Pollen data indicate that the marl prairies west of SRS are not a natural feature of the Everglades landscape but developed after twentieth century hydrologic modification of the system reduced flow to the region (Bernhardt and Willard 2006). Prior to the modifications, plant communities at the sites analyzed by Bernhardt and Willard (2006) in western SRS consisted of sawgrass marshes. The authors concluded that "the current spatial distribution and community composition of marl prairies are a response to water management and land cover changes of the twentieth century; and further sampling of modern marl prairie communities and adjacent communities is necessary to document the pre- and post-drainage distribution of marl prairie" (Bernhardt and Willard 2006).

5.1.5. TREE ISLANDS

Tree islands occur within the freshwater marshes in areas of slightly higher elevation relative to the surrounding marsh. The lower portions of tree islands are dominated by hydrophytic, evergreen, broad-leaved hardwoods such as red bay (*Persea palustris*), sweetbay, dahoon holly (*Ilex cassine*), and pond apple (*Annona glabra*). Tree islands typically have a dense shrub layer that is dominated by coco-plum (*Chrysobalanus icaco*). Additional constituents of the shrub layer commonly include buttonbush and large leather fern (*Acrostichum danaeifolium*). Elevated areas on the upstream side of some tree islands may contain an upland tropical hardwood hammock community dominated by species of West Indian origin (Gunderson et al. 1997), with species composition shifting toward the north toward more temperate hardwood hammock species. Extended periods of flooding may result in tree mortality and conversion to a non-forested community. In the over-drained areas of WCA-3A, historic wildfires have consumed tree island vegetation and soils. Overall, the spatial extent of tree islands in WCA-3 declined by 61% between 1940 and 1995 (Patterson and Finck 1999). Portions of the WCAs have been flooded to the extent that many forested islands have lost all tropical hardwood hammock trees. Tree islands are considered an extremely important contributor to habitat heterogeneity and overall species diversity within the Everglades ecosystem because they provide nesting habitat and refugia for birds and upland species and serve as hotspots of plant species diversity within the Greater Everglades (Sklar and van der Valk 2002, FWS 1999). Tree islands also contain extraordinarily high levels of total phosphorpus in their soil suggesting that they may play a major role in the biogeochemical cycles of nutrients in the Everglades (Troxler and Childers 2010; Wetzel et al. 2009, 2011). Wetzel et al. (2011) found that soil total phosphorpus levels within WCA-3A and WCA-3B tree islands were approximately 4 times higher than the surrounding marsh total phosphorpus levels. Tree islands within WCA-3B may help to capture and focus nutrients, assisting to minimize potential effects on sawgrass and wet prairie communities within this region (Wetzel et al. 2011).

5.1.6. MANGROVES

Mangrove communities are forested wetlands occurring in intertidal, low-wave-energy, estuarine and marine environments. Within the action area, extensive mangrove communities occur in the intertidal zone of Florida Bay. Mangrove forests have a dense canopy dominated by four species: red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood (*Conocarpus erectus*). Mangrove communities occur within a range of salinities from 0 to 40 parts per thousand (ppt). Florida Bay experiences salinities in excess of 40 ppt on a seasonal basis. Declines in freshwater flow through the Everglades have altered the salinity balance and species composition of mangrove communities within Florida Bay. Changes in freshwater flow can lead to an invasion by exotic species such as Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*).

5.1.7. SEAGRASS BEDS

Seagrasses are submerged vascular plants that form dense rooted beds in shallow estuarine and marine environments. This community occurs in subtidal areas that experience moderate wave energy. Within the action area, extensive seagrass beds occur in Florida Bay. The most abundant seagrasses in south Florida are turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*). Additional species include star grass (*Halophila engelmannii*), paddle grass (*Halophila decipiens*), and Johnson's seagrass (*Halophila johnsonii*). Widgeon grass may also occur in seagrass beds in areas of low salinity. Seagrasses have an optimum salinity range of 24 to 35 ppt, but can tolerate considerable short term salinity fluctuations. Large-scale seagrass die-off has occurred in Florida Bay since 1987, with over 18% of the total bay area affected. Suspected causes of seagrass mortality include high salinities and temperatures during the 1980s and long-term reductions of freshwater inflow to Florida Bay (RECOVER 2009).

5.1.8. ROCKLAND PINE FOREST

Pine rocklands within the action area occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. Pine rocklands occur on relatively flat terrain with moderately to well-drained soils. Most sites are wet for only short periods following heavy rains (Florida Natural Areas Inventory 1990). Limestone bedrock is close to the surface and the soils are typically shallow accumulations of sand, marl, and organic material. Pine rockland is an open, savanna-like community with a canopy of scattered south Florida slash pine (*Pinus elliottii* var. *densa*) and an open, low-stature understory. This is a fire-maintained community that requires regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). The overstory is comprised of scattered south Florida slash pines. The shrub layer is comprised of a diverse assemblage of tropical and temperate species. Common shrubs include cabbage palm (*Sabal palmetto*), coco-plum (*Chrysobalanus icaco*), myrsine (*Rapanea punctata*), saw palmetto (*Serenoa repens*), southern sumac (*Rhus copallinum*), strangler fig (*Ficus aurea*), swamp bay (*Persea palustris*), wax myrtle (*Myrica cerifera*), white indigo berry (*Randia aculeata*), and willow-bustic (*Sideroxylon salicifolium*). The herbaceous stratum is comprised of a very diverse assemblage of grasses, sedges, and forbs. Common herbaceous species include crimson bluestem (*Schizachyrium sanguineum*), wire bluestem (*Schizachyrium gracile*), hairy bluestem (*Andropogon longiberbis*), bushy bluestem (*Andropogon glomeratus* var. *pumilis*), candyweed (*Polygala grandiflora*), creeping morning-glory (*Evolvulus sericeus*), pineland heliotrope (*Heliotropium polyphyllum*), rabbit bells (*Crotolaria rotundifolia*), and thistle (*Cirsium horridulum*) (FWS 1999). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, fragmentation, fire suppression, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rockland (FWS 1999).

5.1.9. TROPICAL HARDWOOD HAMMOCK

Tropical hardwood hammocks occur on upland sites where limestone is near the surface. Tropical hardwood hammocks within the action area occur on the Miami Rock Ridge, along the northern shores of Florida Bay and on elevated outcrops on the upstream side of tree islands. This community consists of a closed canopy forest dominated by a diverse assemblage of hardwood tree species, a relatively open shrub layer, and a sparse herbaceous stratum. This community is dominated by West Indian species and contains numerous species whose entire United States distribution is limited to tropical hammocks of south Florida. Common canopy species include gumbo-limbo (*Bursera simaruba*), paradise tree (*Simarouba glauca*), pigeon-plum (*Coccoloba diversifolia*), strangler fig, wild mastic (*Sideroxylon foetidissimum*), willow-bustic, live oak (*Quercus virginiana*), short-leaf fig (*Ficus citrifolia*), and wild tamarind (*Lysiloma bahamense*). Common understory species include black ironwood (*Krugiodendron ferreum*), inkwood (*Exothea paniculata*), lancewood (*Ocotea coriacea*), marlberry (*Ardisia escallonoides*), poisonwood (*Metopium toxiferum*), satinleaf (*Chrysophyllum oliviforme*), and white stopper (*Eugenia axillaris*). Common species of the sparse shrub/herbaceous layer include shiny-leaf wild-coffee (*Psychotria nervosa*), rouge plant (*Rivinia humilis*), false mint (*Dicliptera sexangularis*), bamboo grass (*Lasciacis divaricata*), and woods grass (*Oplismenus hirtellus*). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. Fragmentation of remaining tracts, invasion by exotic species, and alterations of water table elevations have also had negative impacts on this community. Tropical hardwood hammocks on the Miami Rock Ridge have been affected by a lowered water table associated with the reduction of freshwater flow through the Everglades. In contrast, tree islands in the WCAs have been flooded to the extent that many have lost all tropical hardwood hammock trees.

5.2 FEDERALLY LISTED SPECIES

USACE has coordinated the existence of federally listed species with FWS and with NMFS, as appropriate. Specifically, coordination with NMFS includes listed fish and sea turtles at sea. Coordination with FWS includes other listed plants and animals (FWS 2010). Twenty-nine federally listed threatened and endangered species are either known to exist or potentially exist within the action area and, subsequently, may be affected by the proposed action (**Table 2**). Many of these species have been previously affected by habitat impacts resulting from wetland drainage, alteration of hydroperiod, wildfire and water quality degradation.

Federally listed species that are known to exist or potentially exist within ERTP action area are listed in **Table 2**. In addition, as also noted in **Table 2**, a number of candidate animal species are also known to exist or potentially exist within ERTP action area. Adverse effects to federally listed candidate species are not anticipated due to continued implementation of ERTP.

TABLE 2. STATUS OF THREATENED AND ENDANGERED SPECIES LIKELY TO BE AFFECTED BY ERTP AND THE USACE'S AFFECT DETERMINATION

Common Name	Scientific Name	Status	May Affect	No Effect
Mammals				
Florida panther	*Puma concolor coryi*	E	X	
Florida manatee	*Trichechus manatus latirostris*	E, CH		X
Florida bonneted bat	*Eumops floridanus*	E	X	
Birds				
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	X	
Snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	X	
Red-cockaded woodpecker	*Picoides borealis*	E		X
Roseate tern	*Sterna dougallii dougallii*	T		X
Wood stork	*Mycteria americana*	T	X	
Reptiles				
American Alligator	*Alligator mississippiensis*	T, SA	X	
American crocodile	*Crocodylus acutus*	T, CH	X	
Eastern indigo snake	*Drymarchon corais couperi*	T	X	
Gopher tortoise	*Gopherus polyphemus*	C		X
Green sea turtle*	*Chelonia mydas*	E		X
Hawksbill sea turtle*	*Eretmochelys imbricata*	E		X
Kemp's Ridley sea turtle*	*Lipodochelys kempii*	E		X
Leatherback sea turtle*	*Dermochelys coriacea*	E		X
Loggerhead sea turtle*	*Caretta caretta*	E		X
Fish				
Smalltooth sawfish*	*Pristis pectinata*	E, CH		X
Invertebrates				
Bartram's hairstreak butterfly	*Strymon acis bartrami*	E, CH		X
Elkhorn coral*	*Acropora palmata*	T, CH		X
Florida leafwing butterfly	*Anaea troglodyta floridalis*	E, CH		X
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E		X
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E		X
Staghorn coral*	*Acropora cervicornis*	T, CH		X
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T		X
Plants				
Deltoid spurge	*Chamaesyce deltoidea* spp. *Deltoidea*	E	X	
Garber's spurge	*Chamaesyce garberi*	T	X	
Johnson's seagrass*	*Halophila johnsonii*	E, CH		X
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeenis*	E		X
Small's milkpea	*Galactia smallii*	E	X	
Tiny polygala	*Polygala smallii*	E	X	
Blodgett's silverbush	*Argythamnia blodgettii*	C		X
Cape Sable thoroughwort	*Chromolaena frustrata*	E, CH		X
Everglades bully	*Sideroxylon reclinatum* spp. *austrofloridense*	C		X
Florida bristle fern	*Trichomanes punctatum* spp. *Floridanum*	PE		X
Florida pineland crabgrass	*Digitaria pauciflora*	C		X

Pineland sandmat	*Chamaesyce deltoidea* ssp. *Pinetorum*	C		X

*Marine species under the purview of NMFS
E=Endangered; T=Threatened; SA=Similarity of Appearance; CH=Critical Habitat; C=Candidate Species, PE: Proposed endangered

5.3 DESIGNATED CRITICAL HABITAT

In addition to threatened and endangered species, the action area also includes or is adjacent to designated critical habitat for Florida manatee, CSSS, snail kite, American crocodile, Bartram's hairstreak butterfly, Florida leafwing butterfly, Cape Sable thoroughwort, smalltooth sawfish, elkhorn coral, staghorn coral and Johnson's seagrass. Maps of critical habitat locations for these species are depicted in **Figure 11** through **FIGURE 17**. Please note that smalltooth sawfish, elkhorn coral, staghorn coral and Johnson's seagrass fall under the purview of NMFS and thus are not evaluated within this Supplemental Biological Assessment.

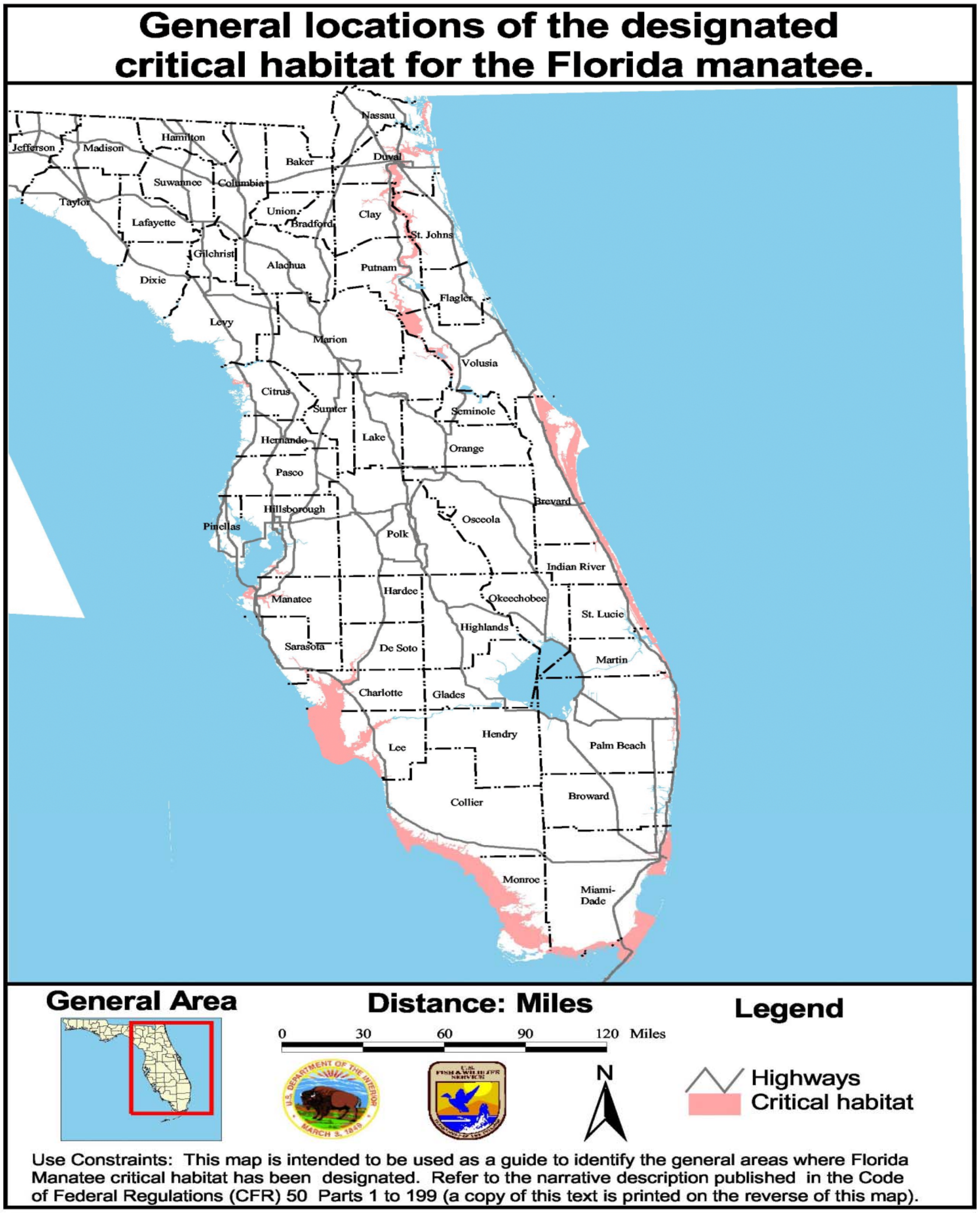


FIGURE 11. CRITICAL HABITAT FOR THE FLORIDA MANATEE

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. 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 action area includes primarily Card, Barnes, Blackwater, Little Blackwater and Manatee sounds.

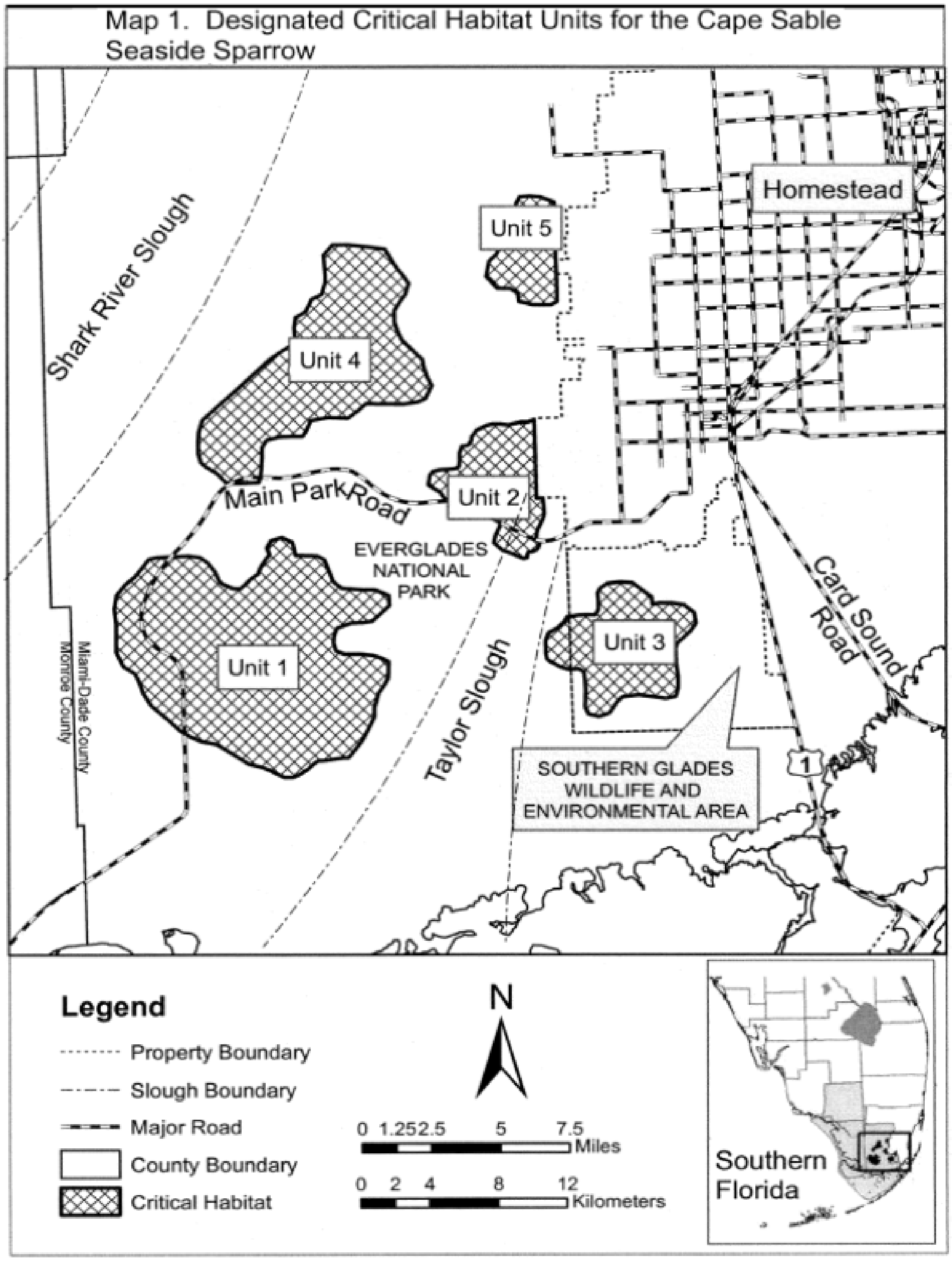


FIGURE 12: CRITICAL HABITAT FOR THE CAPE SABLE SEASIDE SPARROW

Designated critical habitat for the Cape Sable seaside sparrow include areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Dade, and Monroe counties, with the following components: those portions of ENP within T57S R36E, T57S R36E, T57S R37E, T58S R35E, T58S R36E, T58S R37E, T58S R35E, T58S R36E, T59S R35E, T59S R36E, T59S R37E. Areas outside of ENP within T55S R37E Sec. 36; T55S R38E Sec. 31, 32; T56S R37E Sec. 1, 2, 11-14, 23-26; T56S R38E Sec. 5-7, 18, 19; T57S R37E Sec. 5-8; T58S R38E Sec. 27, 29-32; T59S R38E Sec. 4 (CFR Vol. 72, No. 214 / 11-6-07). All of the designated CSSS critical habitat lies within the ERTP action area.

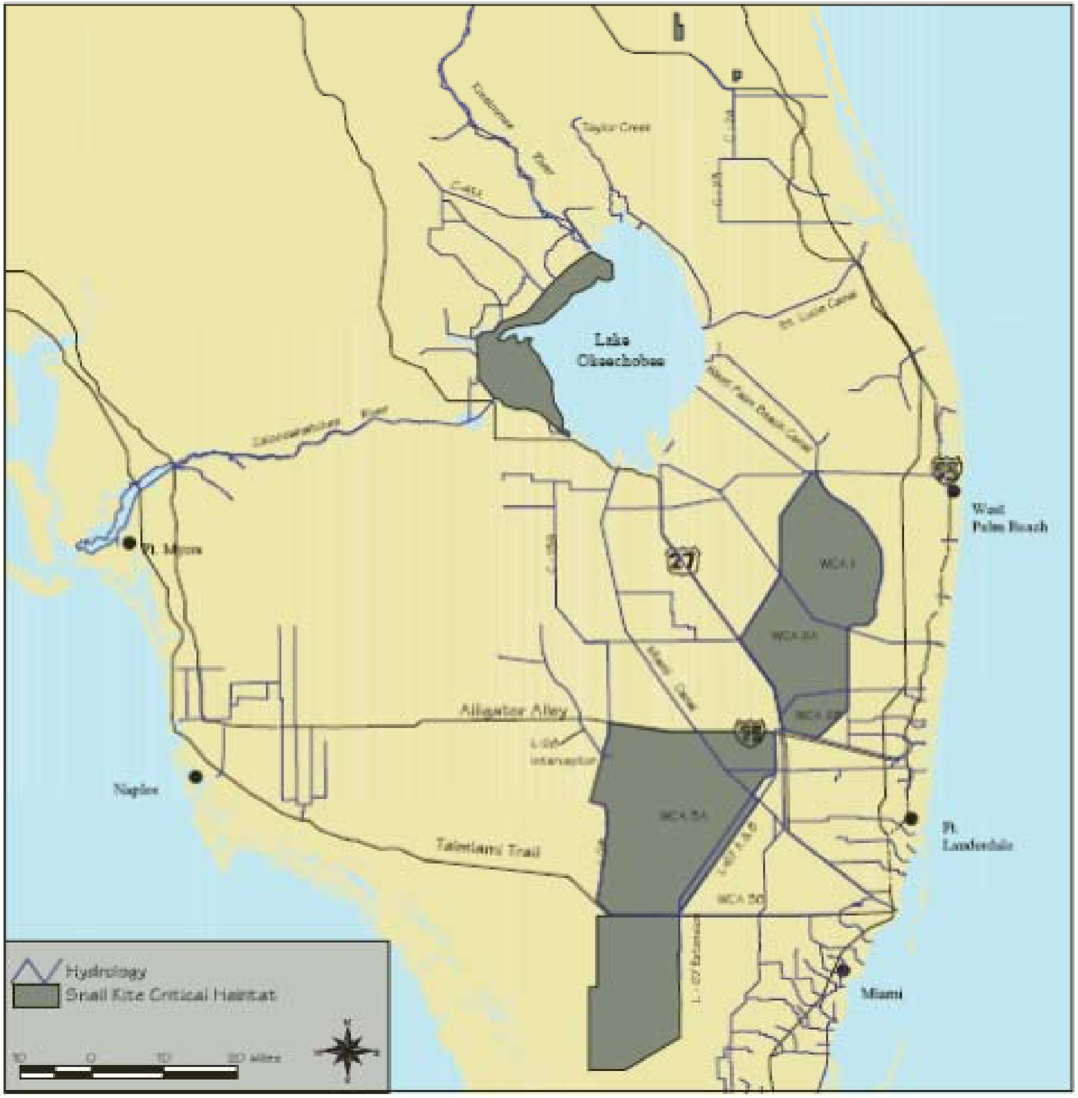


FIGURE 13: CRITICAL HABITAT FOR THE SNAIL KITE

Although previously located in freshwater marshes over considerable areas of peninsular Florida, the range of the snail kite is currently more limited. This bird is now restricted to several impoundments on the headwaters of the St. John's River; the southwest side of Lake Okeechobee; the eastern and southern portions of WCA-1, WCA-2A and WCA-3; the southern portion of WCA-2B; the western edge of WCA-3B; and the northern portion of ENP (FWS 1996-2004). Designated snail kite critical habitat within the ERTP action area includes WCA-1, -2 and -3, along with ENP.

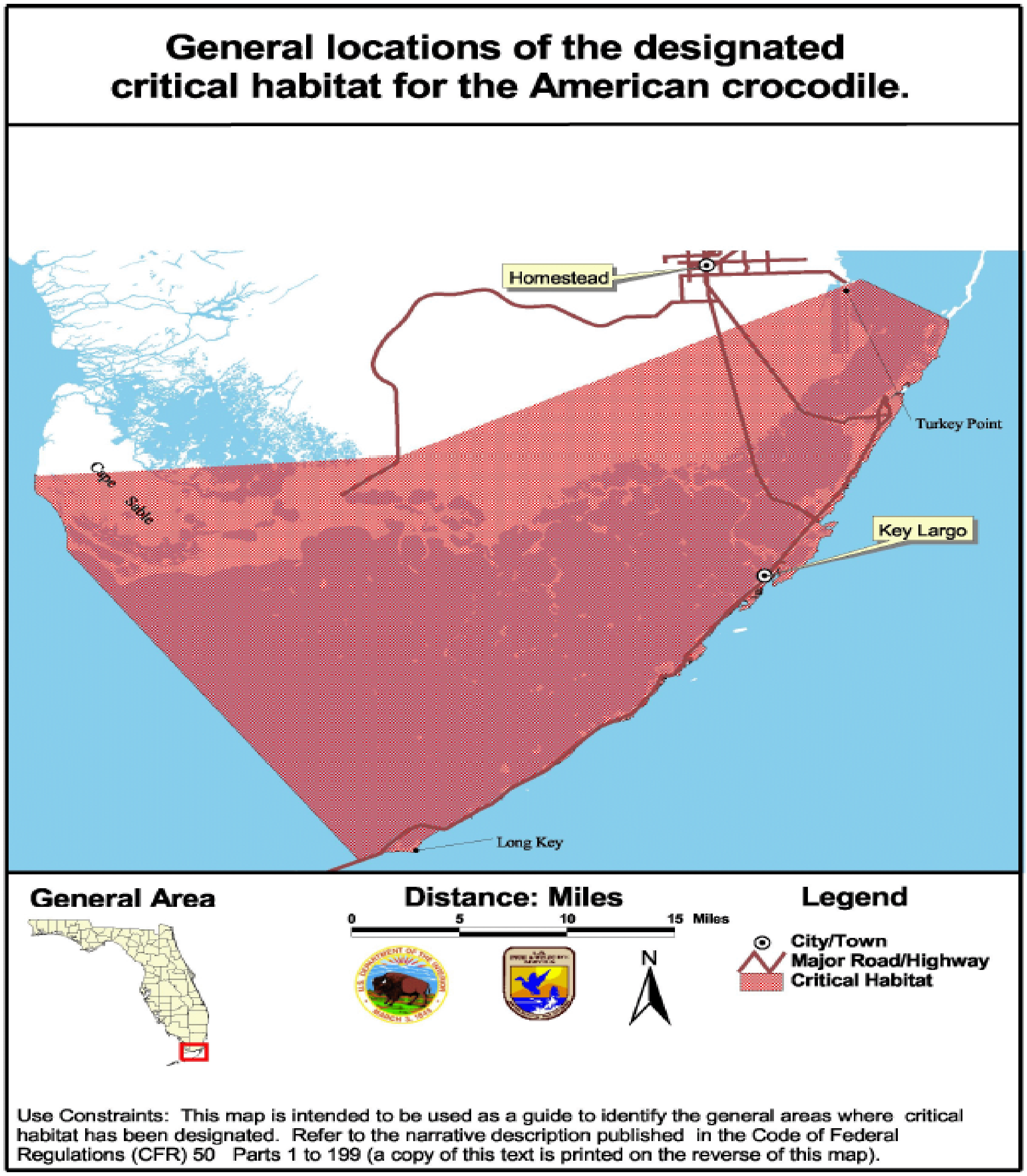


FIGURE 14: CRITICAL HABITAT FOR THE AMERICAN CROCODILE

As defined in the Code of Federal Regulations (CFR) (50 parts 1 to 199; 1 October 2000), the American crocodile's critical habitat includes all land and water within the following boundary: Beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; then southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; then 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; then 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; then eastward along a straight line to the northernmost point of Nine-Mile Pond; then northeastward along a straight line to the point of beginning.

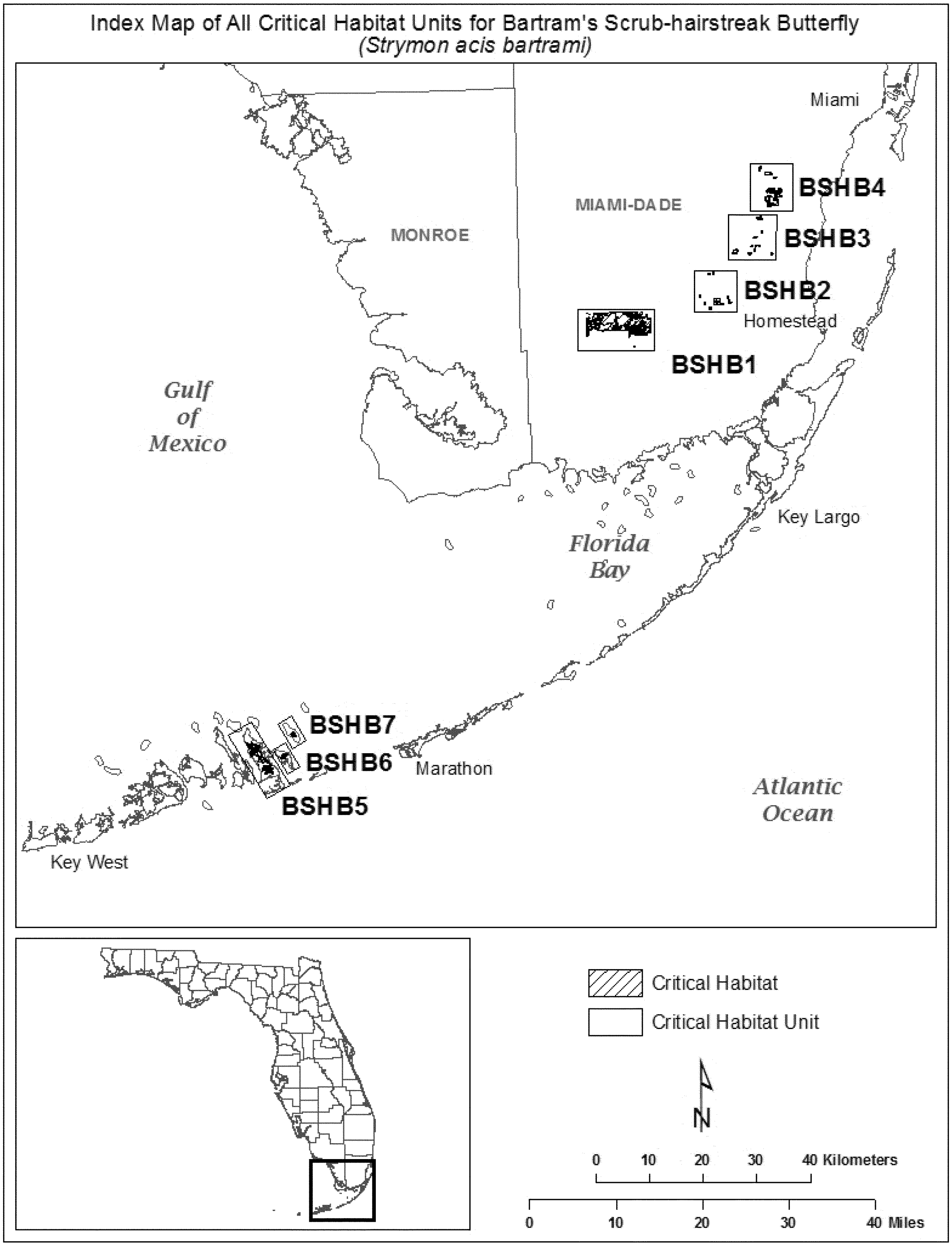


FIGURE 15. CRITICAL HABITAT FOR BRATRAM'S HAIRSTREAK BUTTERFLY

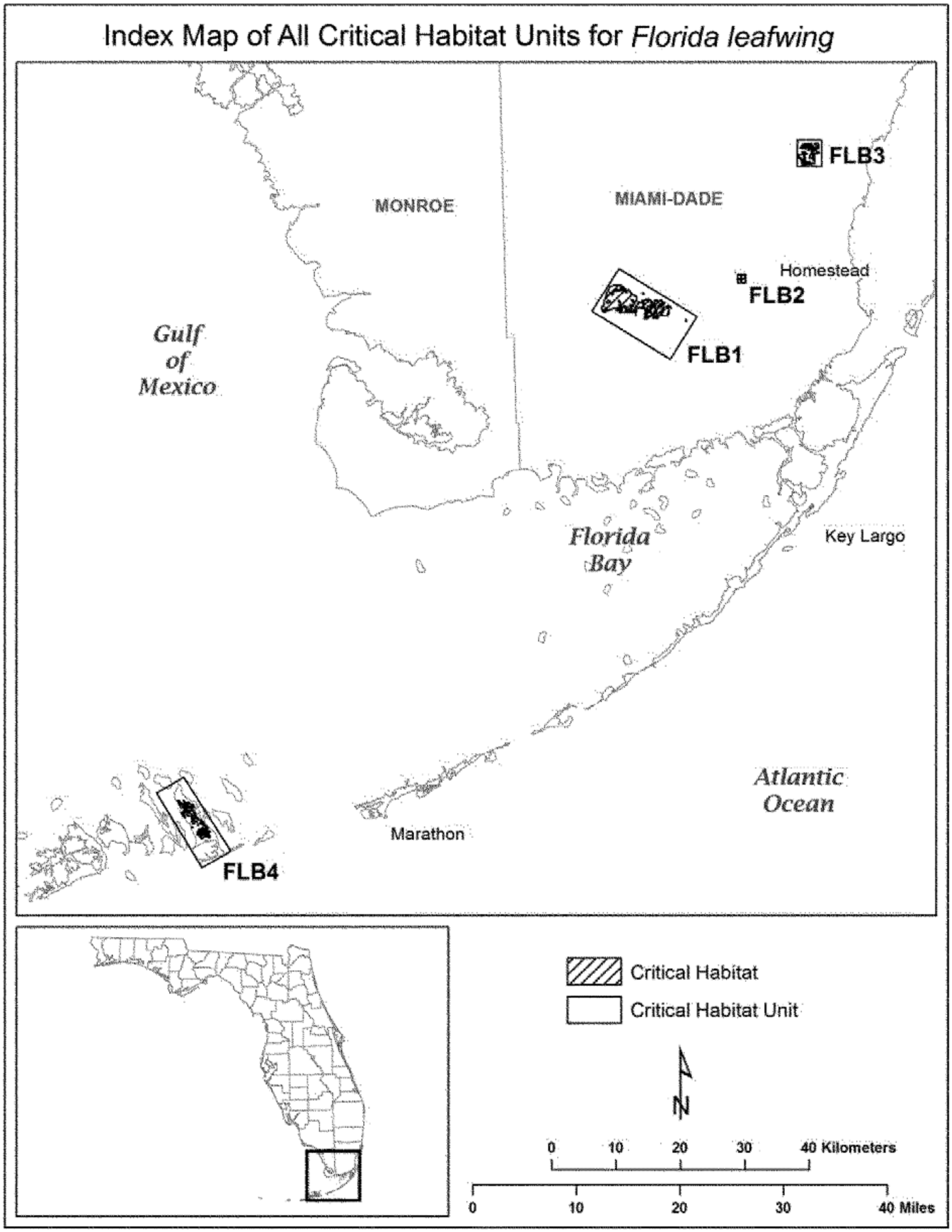


FIGURE 16. CRITICAL HABITAT FOR FLORIDA LEAFWING BUTTERFLY

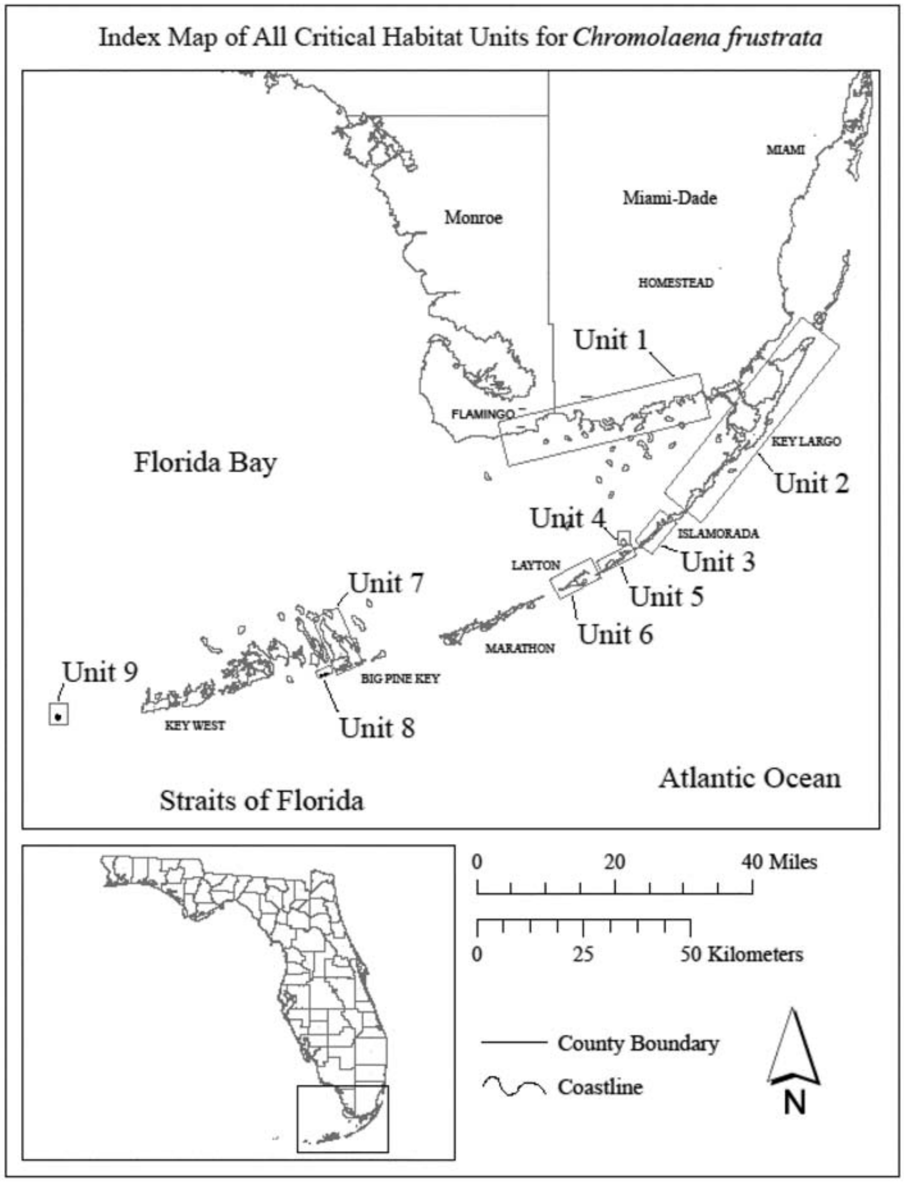


FIGURE 17. CRITICAL HABITAT FOR CAPE SABLE THOROUGHWORT

Critical habitat, designated in January 2014, 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.

5.4 "NO EFFECT" DETERMINATIONS

Federally threatened or endangered species that are known to potentially exist within close proximity of the action area, but which will not likely be of concern are discussed in detail below. These species include Florida manatee and its designated critical habitat, red-cockaded woodpecker, roseate tern, Miami blue butterfly, Schaus swallowtail butterfly, Bartram's hairstreak butterfly and its designated critical habitat, Florida leafwing butterfly and its designated critical habitat, Stock Island tree snail, Okeechobee gourd and Cape Sable thoroughwort and its designated critical habitat.

5.4.1 FLORIDA MANATEE AND "NO EFFECT" DETERMINATION

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 18** illustrates canals that Florida manatees have access to within ERTP action area.

As ERTP 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, USACE has determined that the continued implementation of ERTP and associated reasonable and prudent measures will have no effect on Florida manatee. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Florida manatee. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of the MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

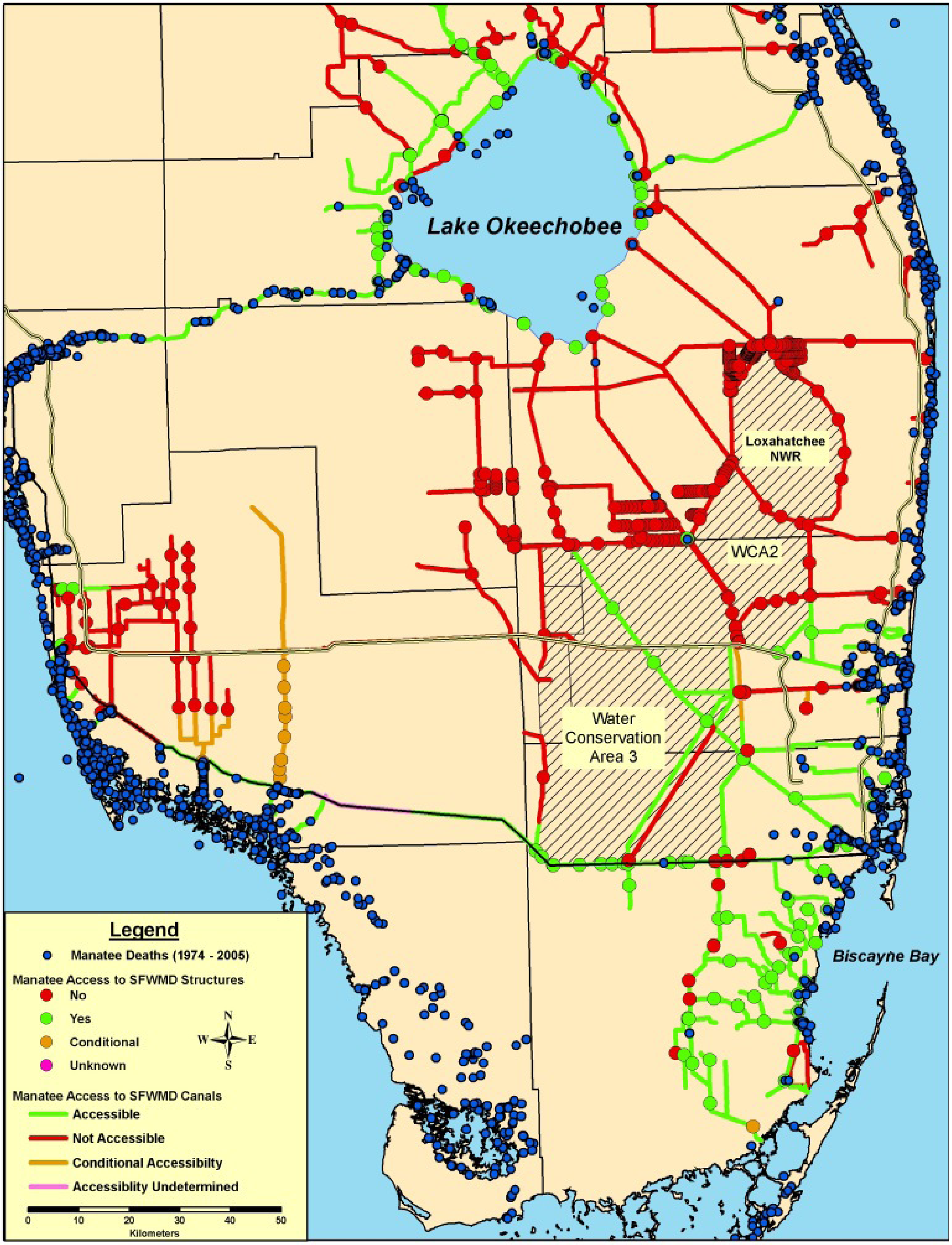


FIGURE 18: CANALS THAT FLORIDA MANATEES HAVE ACCESS TO WITHIN ERTP ACTION AREA

5.4.2 FLORIDA 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 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 (FWS 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 11**). 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 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 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, USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures will have no effect on designated critical habitat for Florida manatee. Additionally, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on designated critical habitat for Florida manatee. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.3 RED-COCKADED WOODPECKER AND "NO EFFECT" DETERMINATION

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. (FWS 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 (FWS 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 red-ring 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, USACE has determined that there would be no effect on this species from the continued implementation of ERTP and associated reasonable and prudent measures. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on red-cockaded woodpecker. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.4 ROSEATE TERN AND "NO EFFECT" DETERMINATION

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 action area, the proposed action is not likely to adversely affect their feeding habits or nesting areas. Therefore, USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures will have no effect on the roseate tern. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that

MWD Increment I Field Test will have no effect on roseate tern. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.5 MIAMI BLUE BUTTERFLY AND "NO EFFECT" DETERMINATION

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 (FWC 2013). 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 USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures would have no effect on Miami blue Butterfly. In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Miami blue butterfly. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.6 SCHAUS SWALLOWTAIL BUTTERFLY AND "NO EFFECT" DETERMINATION

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 limited to tropical hardwood hammocks and is concentrated in the insular portions of Miami-Dade and Monroe counties, from Elliott Key in Biscayne National Park and associated smaller Keys to central Key Largo (FWS 1999). It is estimated that remaining suitable habitat for this species is 43% of the historical suitable habitat in Biscayne National Park and 17% for north Key Largo. The decline has been attributed primarily to habitat destruction (FWS 1999). Due to the lack of preferred subtropical hardwood hammock habitat in the action area, USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures would have no effect on the Schaus swallowtail butterfly. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Schaus swallowtail butterfly. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to Appendix C.

5.4.7 BARTRAM'S HAIRSTREAK BUTTERFLYAND ITS DESIGNATED CIRITCAL HABITAT AND FLORIDA LEAFWING BUTTERFLY AND ITS DESIGNATED CRITICAL HABITAT AND "NO EFFECT" DETERMINATIONS

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.

FWS 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 as illustrated in **Figure 15** and **Figure 16** (FWS 2013b). 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 (ENP 2015).

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 (FWS 2013). 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 (FWS 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 ERTP, 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 USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures will have no effect on Bartram's hairstreak butterfly and its designated critical habitat or Florida leafwing butterfly and its designated critical habitat.

5.4.8 STOCK ISLAND TREE SNAIL AND "NO EFFECT" DETERMINATION

Measuring approximately 45-55 millimeters in length, the arboreal Stock Island tree snail inhabits hardwood hammocks consisting of tropical trees and shrubs such as gumbo limbo, mahogany, ironwood, poisonwood, marlberry and wild coffee, among others. Population declines, habitat destruction and modification, pesticide use and over-collecting led to the listing of this species as threatened in 1978 (FWS 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 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. However, due to the limited amount of preferred subtropical hardwood hammock habitat in the action area, USACE has determined that the continued implementation of ERTP and associated reasonable and prudent measures would have no effect on the Stock Island tree snail. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Stock Island tree snail. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.9 OKEECHOBEE GOURD AND "NO EFFECT" DETERMINATION

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). 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 (FWS 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 range and number of the Okeechobee gourd.

The Okeechobee gourd is shown in the Florida Natural Areas Inventory as not inhabiting any area in Miami-Dade or Broward counties. Therefore, USACE has determined that there would be no effect from continued implementation of ERTP and associated reasonable and prudent measures on this species. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Florida manatee. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.10 CAPE SABLE THOROUGHWORT AND "NO EFFECT" DETERMINATION

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 and associated reasonable and prudent measures are not expected to affect coastal rock barrens; therefore, USACE has determined that the action will have no effect on this species or its designated critical habitat. Furthermore, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Cape Sable thoroughwort. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of the MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.4.11 FLORIDA BRISTLE FERN AND "NO EFFECT" DETERMINATION

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, Zots and Buche 2000). In Florida, the sub-species 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 2014b)*. 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 sub-species include habitat modification and destruction caused by human population growth and development.

Within the action area, pine rocklands occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. Although potentially suitable habitat exists within the action area, USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures will have no effect on the subspecies. Systematic surveys completed in ENP over the years have not been able to find the Florida bristle fern (79 FR 61148; October 9, 2014). In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on either of these species. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5 "MAY AFFECT" DETERMINATIONS

USACE has determined that ERTP may affect Florida panther, Florida bonneted bat, American alligator, American crocodile and its critical habitat, Eastern indigo snake, deltoid spurge, Garber's spurge, Small's milkpea, tiny polygala, CSSS, snail kite and wood stork. USACE recognizes that until completion of CEPP and CERP, there are few opportunities within the current constraints of the C&SF system to completely avoid impacts to listed species. However, the proposed set of reasonable and prudent measures are intended to serve as a transition from ERTP to COP to CERP. This transitional approach allows USACE to take advantage of the best science currently available and to better balance the competing needs of multiple species, as compared to the single-species emphasis embodied in IOP. Although continued implementation of the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the previous operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered snail kite and threatened wood stork.

In the 2010 USACE ERTP Biological Assessment, USACE utilized the defined 2006 IOP Action Area to determine impacts of ERTP on these species. As defined in the 2006 FWS BO, the IOP Action Area encompassed all areas to be directly or indirectly affected by implementation of IOP water management operations (**Figure 4**). The IOP action area and thus the ERTP action area, includes the entire range of the CSSS and snail kite. However, based upon recent information from the University of Florida (Fletcher et al. 2015), USACE has limited the action area for the snail kite to WCA-3 and ENP. The action area for the wood stork includes all of WCA-3 and ENP, in addition to an area encompassing 18.6 miles around any wood stork nesting colony that has been active within the past ten years and occurs within 18.6 miles of WCA-3 or ENP.

Federally listed plant and animal species which may have the potential to be affected by the action are discussed in detail below:

5.5.1 FLORIDA PANTHER AND "MAY EFFECT" DETERMINATION

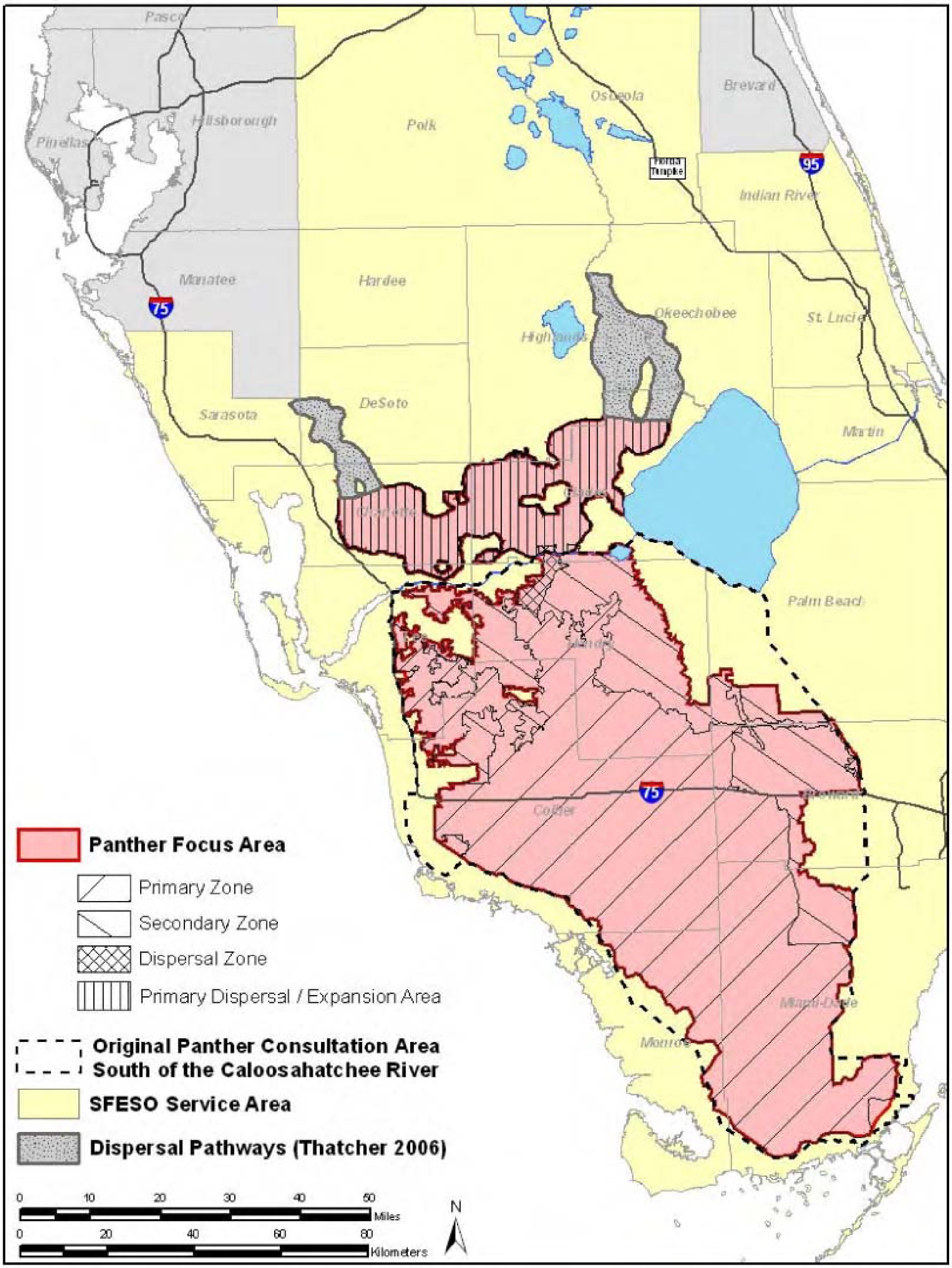
The Florida panther, also known as cougar, mountain lion, puma and catamount, was once the most widely distributed mammal (other than humans) in North and South America, but it is now virtually exterminated in the eastern United States. Habitat loss has driven the subspecies known as the Florida panther 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 white-tailed 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 has the potential to affect both the Primary and Secondary Zones for Florida panther habitat (**Figure 19**).

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 (**FIGURE 20**). Since potentially suitable habitat occurs within the action area, increased water deliveries to ENP could affect Florida panther habitat. However, as lands within ERTP 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, USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures outlined within this Supplemental Biological Assessment may affect, but is not likely to adversely affect, Florida panther.

In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Florida panther. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.



Source: Kautz et al. 2006

FIGURE 19: FLORIDA PANTHER ZONES IN SOUTH FLORIDA

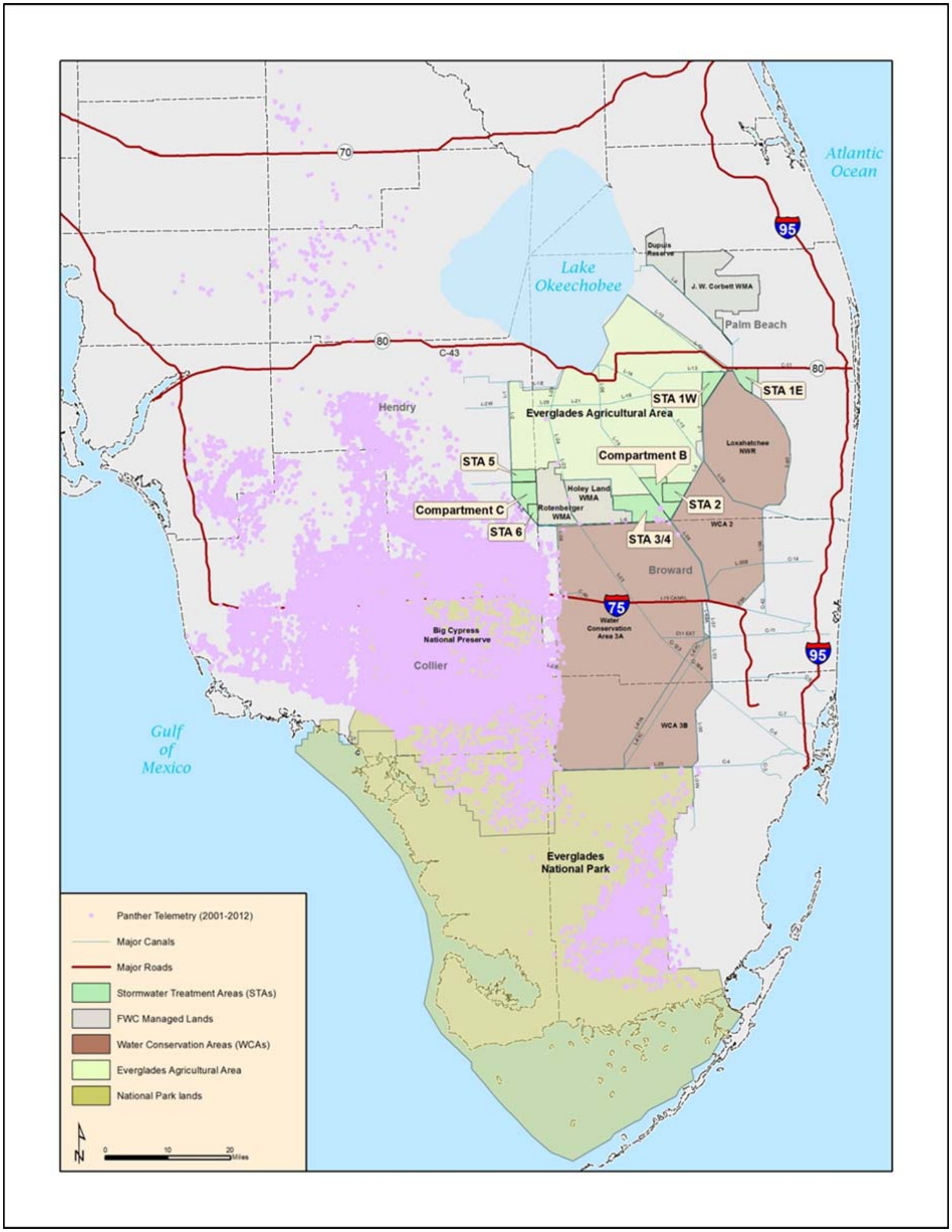


FIGURE 20. FLORIDA PANTHER TELEMETRY INFORMATION FROM 2002 TO 2012

5.5.2 FLORIDA BONNETED BAT AND "MAY EFFECT" DETERMINATION

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 (Scott 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 FWS has defined consultation areas and focal areas for the Florida bonneted bat in south Florida (**FIGURE 21**). The ERTP action area falls within a defined focal area. At present, no active, natural roost sites are known within the action area. All active, known roosts are bat houses. Impacts to potential roost sites are not anticipated under continued implementation of ERTP and associated reasonable and prudent measures. Based on the 2013 Florida Bonneted Bat FWS Consultation guidelines, USACE has determined that the action may affect, but is not likely to adversely affect, this species.

In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test may affect, but is not likely to adversely affect, Florida bonneted bat. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

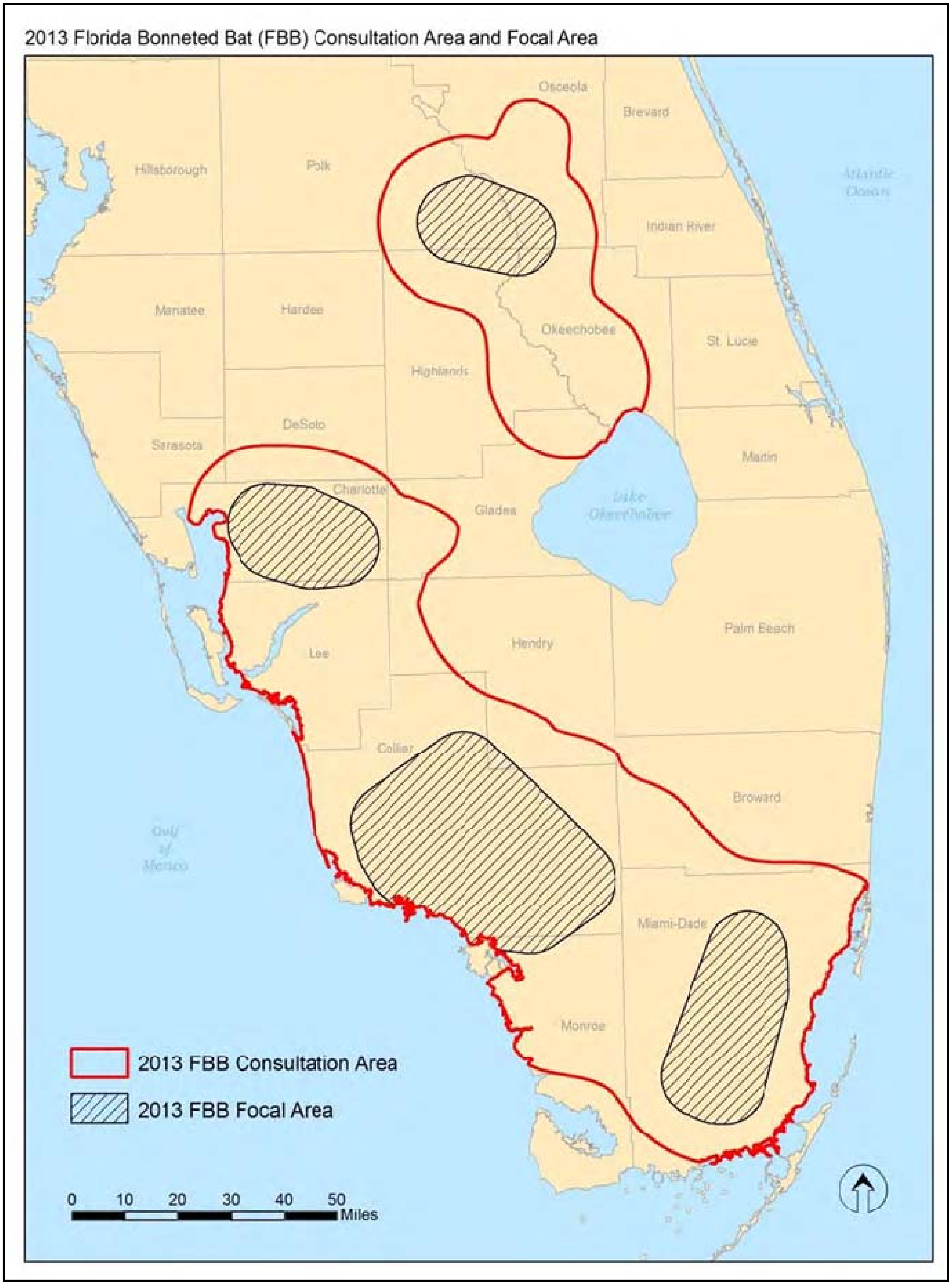


FIGURE 21. FLORIDA BONNETED BAT CONSULTATION AREA

5.5.3 AMERICAN ALLIGATOR AND "MAY EFFECT" DETERMINATION

The American alligator is listed as threatened by the FWS due to similarity of appearance to American crocodile, an endangered species. The American alligator is known to be widespread throughout the action area based upon field observations and the presence of available habitat. The hydrological changes in the timing and distribution of water deliveries as a result of ERTP are not expected to adversely affect American alligator or its habitat. Modifications made under ERTP are transitional between current conditions, COP and full restoration under CERP and thus are designed to benefit multiple species and their habitats, including American alligator. Therefore, continued implementation of ERTP and associated reasonable and prudent measures may affect, but are not likely to adversely affect, American alligator. In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on American alligator. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.4 AMERICAN CROCODILE AND "MAY EFFECT" DETERMINATION

American crocodiles are known to exist throughout ERTP action area (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 premium 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).

Although American crocodile has a high probability of occurrence within the action area due to the presence of available habitat, no adverse impacts to American crocodile are expected. Additionally, as more freshwater is delivered to ENP, overland flows may potentially increase suitable habitat for juvenile crocodiles. The area affected by ERTP represents only a small portion of the species habitat, and therefore, USACE determined that continued implementation of ERTP and associated reasonable and prudent measures may affect, but are not likely to adversely affect, American crocodile. In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on American crocodile. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.5 AMERICAN CROCODILE CRITICAL HABITAT

As defined in CFR (50 parts 1 to 199; 1 October 2000), American crocodile's critical habitat includes all land and water within the following boundary: beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; then southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; then 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; then 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; then eastward along a straight line to the northernmost point of Nine-Mile Pond; then northeastward along a straight line to the point of beginning (**Figure 14**).

According to 50 CFR 17.95, the easternmost tip of Turkey Point defines the northern boundary of designated critical habitat for the American crocodile and that boundary extends southwest throughout Florida Bay. 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 possible that the effects of distributing overland flow through the wetlands into Florida Bay could have effects on tidal wetlands and nearshore salinities that lie within American crocodile critical habitat, but these effects are expected to be minimal. Since, the ideal salinity range for American crocodiles is 0 to 20 ppt; action implementation has the possibility of enhancing American crocodile habitat within the action area, however, the degree to which this may occur is uncertain. It is therefore determined that this action may affect critical habitat for the American crocodile. In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on American crocodile critical habitat. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.6 EASTERN INDIGO SNAKE AND "MAY EFFECT" DETERMINATION

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 1990). 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 1990).

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, USACE 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. In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test will have no effect on Eastern indigo snake. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.7 DELTOID SPURGE, GARBER’S SPURGE, SMALL’S MILKPEA AND TINY POLYGALA AND “MAY EFFECT” DETERMINATIONS

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 (FWS 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, 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 USACE 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.

In addition, in a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test may affect, but is not likely to adversely affect, these species. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.8 CAPE SABLE SEASIDE SPARROW AND "MAY EFFECT" DETERMINATION

Measuring 13-14 centimeters in length, CSSS is one of nine subspecies of seaside sparrows (Werner 1975). CSSS are non-migratory residents of freshwater to brackish marshes and their range is restricted to the lower Florida peninsula. They were originally listed as endangered in 1969 due to their restricted range (FWS 1999). Subsequent changes in their habitat have further reduced their range and continue to threaten this subspecies with extinction.

CSSS appear to prefer mixed marl prairie communities that include muhly grass (*Muhlenbergia filipes*) for nesting (Stevenson and Anderson 1994). These short-hydroperiod (the period of time during which a wetland is covered by water) prairies contain a mosaic of moderately dense, clumped grasses, interspersed with open space that permit ground movements by the sparrows (FWS 1999). According to previous literature, (Werner 1975; Bass and Kushlan 1982), 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 marshes and sites supporting woody vegetation. However, recent research has revealed that CSSS within the Dogleg North plot within sub-population B (CSSS-B) were successfully nesting in "very thick, tall sawgrass" (Virzi and Davis 2013; Slater et al. 2014). Curnett and Pimm (1993) indicated that CSSS also avoid sites with permanent water cover; however, more recent evidence has shown that CSSS successfully nested in areas in which "water levels were extremely high…approaching knee-deep at times with 100% coverage the entire summer" (Virzi and Davis 2013). The combination of hydroperiod and periodic fire events are critical in the maintenance of suitable mixed marl prairie communities for the CSSS (Kushlan and Bass 1983).

CSSS nest in the spring when the marl prairies are dry. While the majority of nesting activities have been observed between March 1 and July 15 when Everglades marl prairies are dry, (Lockwood et al. 1997, 2001), nesting has been reported as early as late February (Werner 1975), and as late as early August (Dean and Morrison 2001). Males will establish breeding territories in early February (Balent et al. 1998) and defend these territories throughout the breeding season (FWS 1999). Male sparrows vocalize to attract females and this particular breeding activity has been shown to decrease with increased surface water conditions (Nott et al. 1998; Curnutt and Pimm 1993).

Successful CSSS breeding requires that breeding season water levels remain at or below ground level in the breeding habitat. Nott et al. (1998) cited a "10-centimeter (cm)" rule for maximum water depth over which the CSSS will initiate nesting. This conclusion was based upon observations within the ENP range-wide survey in which no singing males were heard when water depths exceeded that level. However, Dean and Morrison (1998) demonstrated that nesting may occur when average water depths exceed this rule. In addition, more recent evidence has shown that not only were CSSS able to successfully breed in areas with standing water that was "approaching knee deep at times"; but also that they were able to successfully produce multiple broods (3) in the Dogleg Plot of CSSS-B "despite heavy rains that began in early-May and deep water levels that persisted throughout the breeding season in the study plot" (Virzi and Davis 2013; Slater et al. 2014).

CSSS construct their nests relatively close to the ground in clumps of grasses composed primarily of muhly, beakrushes (*Rhynchospora* spp.) and Florida little bluestem (*Schizachyrium rhizomatum)* (Pimm et al. 2002). The average early season nest height is 17 centimeters (6.7 inches) above ground, while the average late season nest height is 21 centimeters (8.3 inches) above ground (Lockwood et al. 2001). The shift in average nest height after the onset of the wet season rainfall pattern, which typically begins in early June (Lockwood et al. 2001), appears to be an adaptive response to rising surface water conditions. In general, the CSSS will raise one or two broods within a season; however, if weather conditions permit, a third brood is possible (Kushlan et al. 1982; FWS 1983). A new nest is constructed for each successive brood. The end of the breeding season is triggered by the onset of the rainy season when ground water levels rise above the height of the nest off the ground (Lockwood et al. 1997).

CSSS will 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. 2009b). The nest cycle lasts between 34 and 44 days in length and includes a 12-13 day incubation period, 9-11 day nestling period and 10-20 days of post-fledgling care by both parents (Sprunt 1968; Trost 1968; Woolfenden 1956, 1968; Lockwood et al. 1997; Pimm et al. 2002). Nest success rate varies between 21 and 60 percent, depending upon timing of nest initiation within the breeding season (Baiser et al. 2008; Boulton et al. 2009a). Substantially higher nest success rates occur within the early portion of the breeding season (approximately 60% prior to June 1) followed by a decline in success as the breeding season progresses to a low of approximately 21% after June 1(Baiser et al. 2008; Boulton et al. 2009a; Virzi et al. 2009). In most years, June 1 is a good division between the early high success period and the later, lower success period (Dr. Julie Lockwood email correspondence to FWS, October 15, 2009). Nearly all nests that fail appear to fail due to predation, and predation rates appear to increase as water level increases (Lockwood et al. 1997, 2001; Baiser et al. 2008). A complete array of nest predators has not been determined. However, raccoons *(Procyon lotor*), rice rats *(Oryzomys palustri*s), and snakes, including exotic pythons, may be the chief predators (Lockwood et al. 1997; Dean and Morrison 1998; Post 2007).

A dietary generalist, CSSS feed by gleaning food items from low-lying vegetation (Ehrlich et al. 1992; Pimm et al. 2002). Common components of their diet include soft-bodied insects such as grasshoppers, spiders, moths, caterpillars, beetles, dragonflies, wasps, marine worms, shrimp, grass and sedge seeds (Stevenson and Anderson 1994). The importance of individual food items appear to shift in response to their availability (Pimm et al. 2002).

CSSS are non-migratory with males displaying high site fidelity, defending the same territory for two to three years (Werner 1975). CSSS are capable of both short-distance and longer-range movements, but appear to be restricted to short hydroperiod prairie habitat (Dean and Morrison 1998). Large expanses of deep water or wooded habitat act as barriers to long-range movements (Dean and Morrison 1998). Recent research by Julie Lockwood, Ph.D. of Rutgers University and her students have revealed substantial movements between subpopulations east of Shark River Slough (Lockwood et al. 2008; Virzi et al. 2009), suggesting that CSSS has considerable capacity to colonize unoccupied suitable habitat (Sustainable Ecosystems Institute 2007).

In the 1930s, Cape Sable was the only known breeding range for CSSS (Nicholson 1928). Areas on Cape Sable that were occupied by CSSS in the 1930s have experienced a shift in vegetative communities from freshwater vegetation to mangroves, bare mud flats, and salt-tolerant plants, such as turtleweed (*Batis maritima*) and bushy seaside tansy (*Borrichia frutescens*) (Kushlan and Bass 1983). As a result, CSSS no longer use this area. More recently, continued alterations of CSSS habitat have occurred as a result of changes in the distribution, timing, and quantity of water flows in south Florida. Water flow changes and associated shifts in vegetation appear to be the leading contributor to the decline in CSSS population, which subsequently threaten the subspecies with extinction. Competition and predation also threatens CSSS.

Presently, the known distribution of CSSS is restricted to two areas of marl prairies east and west of Shark River Slough in the Everglades region (within ENP and BCNP) and the edge of Taylor Slough in the Southern Glades Wildlife and Environmental Area in Miami-Dade County. ENP staff first undertook a comprehensive survey of CSSS in 1981 to identify all areas where sparrows were present. This survey, hereafter referred to as the range-wide survey, resulted in the first complete range map for CSSS (Bass and Kushlan 1982; Kushlan and Bass 1983). The survey design consisted of a one-kilometer survey grid over any suspected CSSS habitat. As much of CSSS habitat is inaccessible, a helicopter was employed and landed at the intersection of each grid line (*i.e.* every 1 kilometer). At each site, the researchers would record every CSSS seen or heard (singing males) within an approximate 200 meter radius of their landing location (Curnutt et al. 1998). From the resulting range map, Curnutt et al. (1998) divided CSSS into six separate subpopulations, labeled as A through F (**Figure 22**), with subpopulation A (CSSS-A) as the only subpopulation west of Shark River Slough.

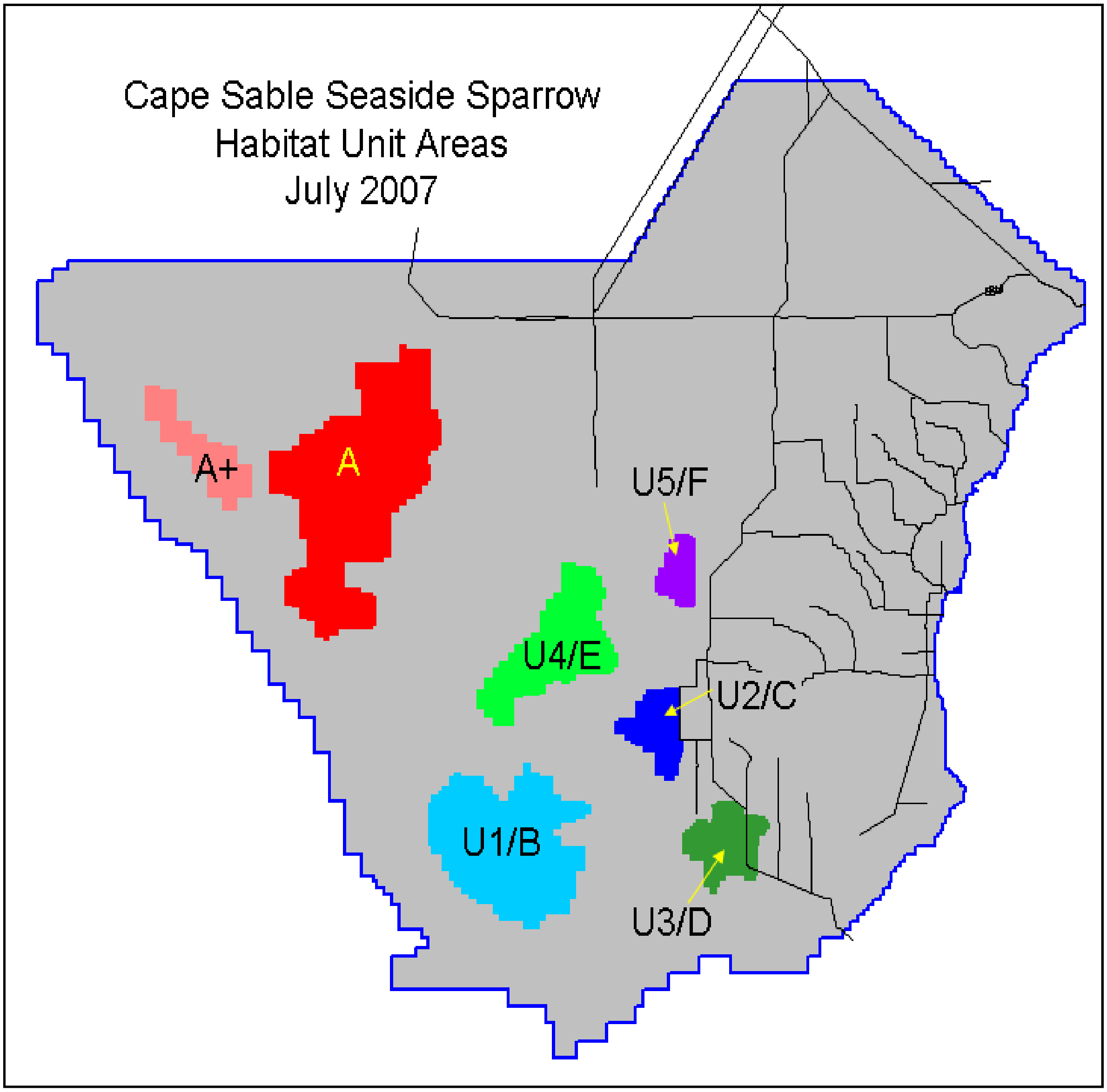


FIGURE 22: CAPE SABLE SEASIDE SPARROW SUBPOPULATIONS (A-F) AND DESIGNATED CRITICAL HABITAT UNITS (U1-U5)

After the 1981 survey, the population was not surveyed again until 1992. The range-wide survey has been performed annually since 1992, although the number of survey locations has changed from a high of over 850 sites in 1992 to a low of 250 sites in 1995 (Cassey et al. 2007).

Bass and Kushlan (1982) also devised a methodology of translating the range-wide survey results into an estimate of population size. To account for females (only males sing) and CSSS outside the audio detection range, the number of birds counted is multiplied by a factor of sixteen (15.87 rounded to 16). In order to confirm the validity of this estimation factor, Curnutt et al. (1998) compared the bird counts from the range-wide survey with actual mapped territories on intensive study plots and found it to be adequate given normal population fluctuations. More recent research indicates that this estimation factor may be overestimating population abundance within the smaller CSSS subpopulations (*i.e.* CSSS-A, C, D, F) due to the presence of floater males and a male-biased sex ratio (Boulton et al. 2009a). During CEPP ESA consultation, it was noted that a new population estimation methodology was necessary to more accurately assess small CSSS populations in light of this evidence. As a result, FWS has included within its CSSS MOU a provision for development of a new CSSS population estimation tool.

Based on the range-wide surveys, total CSSS populations have declined from approximately 6,600 individuals during the period from 1981-1992, to approximately 3,216 in 2015 (**Table 3**). Although populations decreased significantly during the early part of that time period, they have remained relatively constant since 1993 (**Figure 23**). Recognizing the limitations of the range-wide survey in detecting fine-scale changes in population abundance related to management actions (Walters et al. 2000; Lockwood et al. 2006), Cassey et al. (2007) translated the results of the range-wide survey into presence/absence data and then converted it into a measure of occupancy. In their study, occupancy was defined as the fraction of the area occupied by the species in any one year as employed by MacKenzie et al. (2002). Their results show that the proportion of CSSS range occupied decreased between 1981 and 1992, particularly in CSSS-C, CSSS-D and CSSS-F; with a second period of decline between 1992 and 1996, most notably within CSSS-A. After 1996 overall occupancy has remained relatively constant (Cassey et al. 2007).

TABLE 3: CAPE SABLE SEASIDE SPARROW BIRD COUNT AND POPULATION ESTIMATES BY YEAR AS RECORDED BY THE EVERGLADES NATIONAL PARK RANGE-WIDE SURVEY

Population/ Year	CSSS-A		CSSS-B		CSSS-C		CSSS-D		CSSS-E		CSSS-F		Total	
	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST
2001	8	128	133	2,128	6	96	2	32	53	848	2	32	204	3,264
2002	6	96	119	1,904	7	112	0	0	36	576	1	16	169	2,704
2003	8	128	148	2,368	6	96	0	0	37	592	2	32	201	3,216
2004	1	16	174	2,784	8	128	0	0	40	640	1	16	224	3,584
2005	5	80	142	2,272	5	80	3	48	36	576	2	32	193	3,088
2006	7	112	130	2,080	10	160	0	0	44	704	2	32	193	3,088
2007	4	64	157	2,512	3	48	0	0	35	560	0	0	199	3,184
2008	7	112	NS	NS	3	48	1	16	23	368	0	0	34	544*
2009	6	96	NS	NS	3	48	2	32	27	432	0	0	38	608*
2010	8	128	119	1904	2	32	4	64	57	912	1	16	191	3,056
2011	11	176	NS	NS	11	176	1	16	37	592	2	32	62	992^
2012	21	336	NS	NS	6	96	14	224	46	736	4	64	91	1,456^
2013	18	288	112	1792	8	128	1	16	45	720	1	16	185	2,960
2014	4	64	114	1824	7	112	2	32	42	672	1	16	170	2720
2015+	13	208	120	1920	7	112	4	64	55	880	2	32	201	3216

BC: Bird Count; EST: Estimate; NS: Not Surveyed

* These numbers do not reflect a significant decline in CSSS population. CSSS-B, the largest and most stable subpopulation, was not surveyed in 2008 or 2009. Adding the 2007 CSSS-B population estimate of 2,512 birds to those of the other subpopulations, the estimated total CSSS population size is 3,056 and 3,120 birds for 2008 and 2009, respectively.

^ These numbers do not reflect a significant decline in CSSS population. CSSS-B, the largest and most stable subpopulation, was not surveyed in 2011 or 2012. Adding the 2010 CSSS-B population estimate of 1,904 birds to those of the other subpopulations, the estimated total CSSS population size is 2,896 and 3,360 birds for 2011 and 2012, respectively.

+ Please note that these data have not gone through ENP's Quality Assurance/Quality Control process and are subject to change.

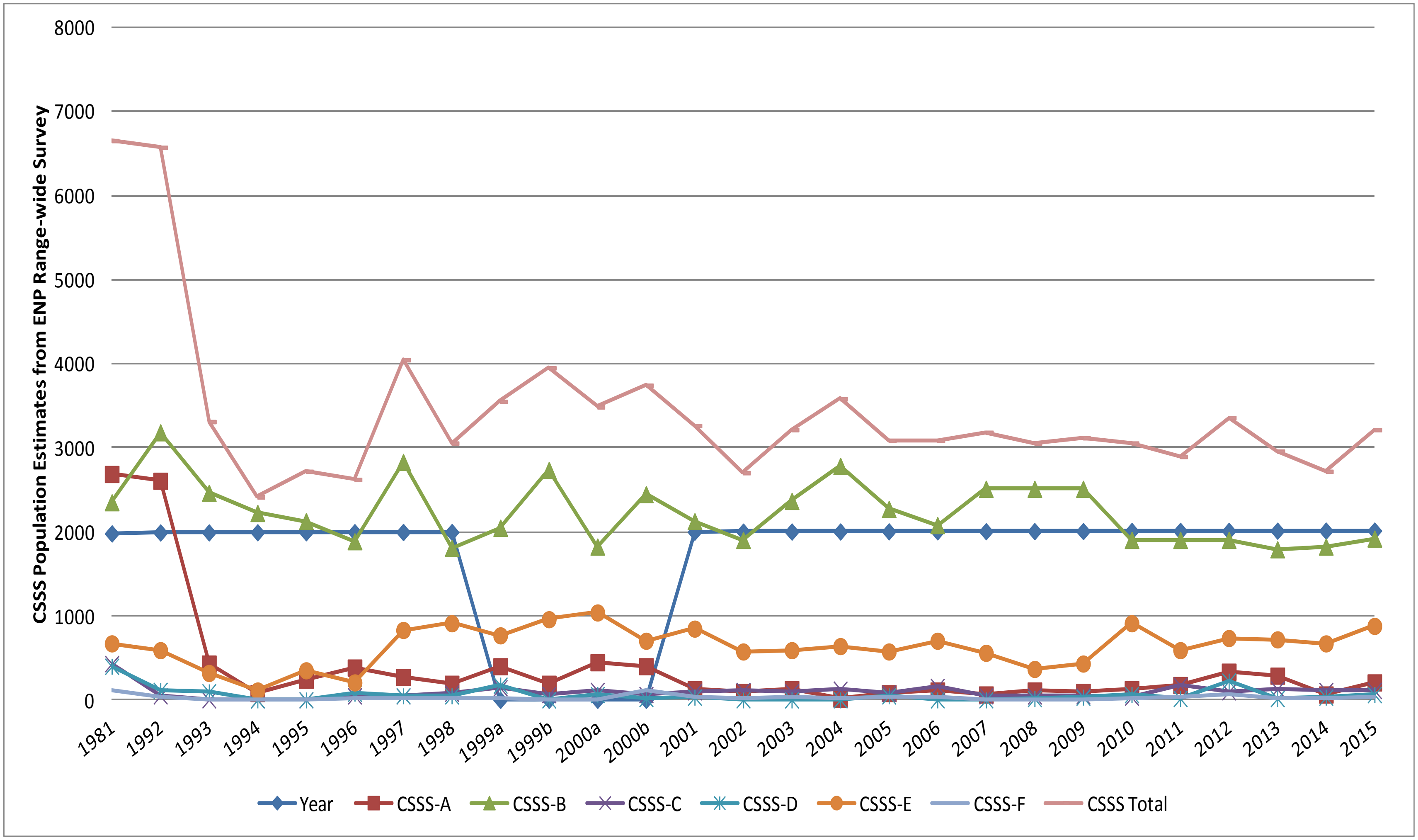


FIGURE 23: CAPE SABLE SEASIDE SPARROW POPULATION ESTIMATES WITHIN EACH SUBPOPULATION AS REPORTED FROM THE EVERGLADES NATIONAL PARK RANGE-WIDE SURVEYS

CSSS-A, once thought to be critical to the existence of CSSS, is located in western Shark River Slough south of water discharges out of WCA-3A through the S-12 structures. Unusually intense and unseasonable rainy periods during the winter of 1992/93 and again in 1993/94 and 1994/95 caused prolonged flooding in CSSS-A, sufficient enough that the high water levels may have nearly precluded breeding in 1993 and 1995 (Walters et al. 2000). In addition, little or no breeding was possible during the 1994 and 1996 breeding seasons, due to the limited availability of suitable dry habitat. The flooding of the habitat by direct rainfall was compounded by discharges of water through the S-12 structures needed to meet the regulation schedule for WCA-3A. With an average life-span of two to three years, several consecutive years with little or no reproduction, could significantly affect population size. This is reflected in the reduction of sparrows detected in subsequent surveys in CSSS-A, in addition to the reduction in occupancy reported by Cassey et al. (2007) for the time period between 1992 and 1996. As a consequence, FWS issued a BO in 1999 providing recommendations to USACE on how water levels should be controlled within CSSS-A nesting habitat so that the existence of the CSSS would not be jeopardized. The USACE responded by developing changes in water management operations through emergency deviations in 1998 and 1999, two iterations of ISOP in 2000 and 2001, culminating in IOP in 2002 and 2006 and then replaced in 2012 by ERTP, in order to address other endangered species concerns. ERTP has been in effect since October 2012. ISOP/IOP/ERTP goals were to keep subpopulations (particularly CSSS-A) dry during the breeding season and to also keep the habitat for sub-populations B, C, D, E, and F (CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F) from excessive drying in order to prevent adverse habitat change from unseasonable fire frequencies.

The primary objective in implementing IOP and maintaining CSSS water management operational restrictions under ERTP was to reduce high water levels within CSSS habitat west of Shark River Slough (*i.e.* CSSS-A). Water management operations designed to protect CSSS to the maximum extent possible during the nesting season in order to achieve FWS RPA to provide an improved opportunity for nesting by maintaining water levels below ground level for a minimum of 60 consecutive days between March 1 and July 15, corresponding to the CSSS breeding season. In addition, a secondary purpose of IOP was to allow CSSS habitat to recover from prolonged flooding during the mid-1990s. It is recognized in the 1999 FWS BO that there could be times when unseasonable rainfall events could overwhelm the ability of the water management system to provide the necessary dry conditions. Following implementation of IOP, the FWS recommendations for protection of the CSSS in CSSS-A were met in 2002, 2004, 2006, 2008 and 2009. Direct rainfall on CSSS-A prevented attainment of FWS RPA requirements for 2003, 2005 and 2007. Since 2010 FWS BO for ERTP, FWS recommendations for protection of CSSS-A were met in 2010, 2011, 2012, 2014 and 2015. Direct rainfall on CSSS-A in 2013 prevented meeting FWS RPA requirement of 60 consecutive dry days as measured at NP-205 between March 1 and July 15. As reported from the range-wide survey (**Table 3**), the estimated total CSSS population during IOP and ERTP has remained between 2,704 birds (2002) and 3,584 birds (2004). CSSS-A population estimates during IOP and ERTP ranged from a low of 16 (1 bird counted) in 2004 to a high of 336 (21 birds counted) in 2012. The population estimates for CSSS-A may be inflated due to the potential inaccuracy of the estimation factor in smaller subpopulations as suggested by recent research (Boulton et al. 2009a). In addition, it should also be noted that the estimates for a particular year have relevance for potential breeding that year, but this would not be reflected in the population estimates until the following year.

Another factor in lack of recovery is change in vegetative structure resulting from physical alterations during the high water events of 1993 through 1995 and a shift in the vegetative community dominants away from previous species. This phenomenon was studied by Michael Ross, Ph.D. and Jay Sah, Ph.D. of Florida International University, along with James Synder of the United States Geological Survey (USGS) in a 2003-2009 monitoring study funded by USACE (Ross et al. 2003, 2004, 2006; Sah et al. 2007, 2008, 2009). Based upon several years of vegetation studies within CSSS habitat, the researchers concluded that the direction and magnitude of short-term vegetation change within marl prairie is dependent upon the position of the habitat within the landscape. Efforts to regulate operations of S-12 structures under ISOP/IOP/ERTP to protect CSSS-A and its habitat west of Shark River Slough have resulted in lower water depths during the sparrow breeding season as measured at Gauge NP-205. However, the persistence of wetter vegetation within the vicinity of gauge P-34 may have limited the recovery of CSSS-A within this part of its habitat. This suggests water flow from the northwest (*i.e.* western flows) and/or from changes in groundwater related to sea level rise may have resulted in deeper water levels and longer hydroperiods within this portion of CSSS-A habitat. This is one factor underlying the need for the Water Flow Analysis Test, as well as exploring options for the L-28 Borrow Canal. As shown in **Table 3**, CSSS-A has not recovered under IOP/ERTP operations, but has remained relatively stable since its implementation. Recent research suggests that sparrow populations are slow to recover, or cannot recover, once they reach very small population sizes due to low adult and juvenile recruitment, many unmated males, biased sex ratios, lower hatch rates and other adverse effects associated with small population size (*i.e.* the Allee effect) (Boulton et al. 2009a; Virzi et al. 2009). Virzi and Davis (2013) and Slater et al. (2014) have documented highly skewed sex ratios in favor of males within smaller CSSS populations studied (*i.e.* CSSS-A and CSSS-D) along with lower nest success rates. This in addition to low return rate for males within CSSS-A, led Virzi and Davis (2013) to suggest that CSSS-A may be dropping below a critical threshold necessary to attract settling males due to lack of conspecific cues.

Vegetation change is mediated by the interaction of fire and hydrology. Studies by Sah et al. (2009) 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 in turn, could potentially impede recolonization by CSSS (Sah et al. 2009). The transition from one vegetation type to another (e.g. prairie to marsh) in response to hydrology may take place in as little as three to four years (Armentano et al. 2006), however, the transition from marsh to prairie may take longer (Ross et al. 2006, Sah et al. 2009). Vegetation studies within CSSS habitat (Ross et al. 2004) have shown that CSSS occupy prairies with a hydroperiod ranging between 90 and 240 days. ERTP ET 2 addresses this hydroperiod requirement. However, solely attaining this hydroperiod requirement may not be enough to promote a transition from marsh to prairie habitat, as this likely requires the process of fire (Ross et al. 2006, Sah et al. 2009). Recent research by Slater et al. (2014) noted the presence of apparently suitable sparrow habitat within the Lower Meadow of CSSS-A that had burned in 2009. This area had supported numerous breeding territories prior to the burn (La Puma et al. 2007); however in 2014 it remained unoccupied. Slater et al. (2014) speculate that there may not be enough surplus birds to recolonize this habitat, underscoring the hypothesis that CSSS-A may have reached a critical threshold due to small population size and may be unable to recover without intervention (e.g.. translocation).

5.5.8.1 POTENTIAL EFFECTS TO CAPE SABLE SEASIDE SPARROW

USACE recognizes that there are few opportunities within the current constraints of the C&SF system to completely avoid impacts to listed species. However, ERTP represents a transition from the single species management embodied within IOP to multi-species management to better meet the requirements of multiple species, including other endangered bird species. ERTP superseded IOP with the goal of providing favorable hydrological conditions for multiple wildlife species and the habitats upon which they depend, while continuing to provide a nesting window for the CSSS, particularly within CSSS-A.

Components of ERTP that potentially may affect CSSS subpopulations include the WCA-3A Interim Regulation Schedule, elimination of IOP restriction dates on S-12C structure and Tram Road stoppers. Other ERTP action components that will have little impact on the CSSS include S-346 and S-332D operations, Rainfall Plan Target Flows and Pre-storm, Storm, and Storm Recovery Operations for the SDCS. In addition, WCA-3A PSC will provide a mechanism to evaluate hydrological and ecological conditions within CSSS habitat to allow for adaptive management of the system to protect the needs of multiple species, including CSSS. A detailed evaluation of these ERTP components was included within the October 2010 ERTP Biological Assessment and are hereby incorporated as reference. This section of this Supplemental Biological Assessment will explore potential effects attributed to the five main reasonable and prudent measures under USACE authority identified during informal consultation that may act to further protect CSSS. These include 1) MWD Project Increment 1 Field Test; 2) implementation of operational flexibility within ERTP to protect CSSS; 3) a Water Flow Analysis Test; 4) MWD Increment 2 Field Test; and 5) Combined Operational Plan (i.e. MWD Increment 3). In addition, USACE will prepare an assessment, using an interagency team, of potential effects of Levee 28 (L-28) Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, USACE has not yet determined what authority might be required for such action. It is important to note as described within Section 4.10 and Section 4.11, affects on listed species as result of implementation of MWD Increment 2 and COP will be detailed under separate ESA consultation and thus are not assessed within this Supplemental Biological Assessment.

5.5.8.1.1 MWD INCREMENT 1 FIELD TEST

Since 1999, through the 1998 and 1999 Emergency Deviation, ISOP, IOP and ERTP, FWS has always maintained that moving water to the east through the historical flow path into NESRS was the solution to improve nesting and habitat conditions for CSSS. By reducing limitations on S-333, more water will be delivered to NESRS. Implementation of MWD Increment 1 Field Test is not expected to alter the physical and biological features essential to the nesting success and overall conservation of the subspecies. In order to protect CSSS, structural closings implemented under 2006 IOP and preserved under 2012 ERTP will be retained under the field test. The action related hydrologic changes are expected to be temporary due to the limited duration of the field test. In addition, relaxation of G-3273 constraint is a Term and Condition under 2010 FWS ERTP BO. 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). Over this cumulative historical hydrologic analysis period, the MWD Increment 1 Field Test would be expected to increase the number of unconstrained discharges from WCA-3A to NESRS by up to 1,176 days, a 64% increase relative to ERTP, with the majority of increased flows to NESRS anticipated during the months of June through December. Increased water in NESRS or within the C-111 SD Project area may potentially affect CSSS and its habitat by increasing hydroperiod. All regulatory monitoring requirements included in the 2009 C-111 Spreader Canal Western Project BO and 2010 ERTP BO will continue as mandated within those opinions. However, USACE proposed an additional assessment metric to examine potential hydrologic effects within CSSS subpopulations and critical habitat units (*i.e.* CSSS-F/Unit 5, CSSS-E/Unit 4, CSSS-C/Unit 2) throughout MWD Increment 1 Field Test as described with **Appendix C**. USACE will also conduct a spreadsheet tracking analysis to quantify how revised operations under MWD Increment 1 Field Test reduce flows through the S-12A, S-343A, S-343B, S-344 and S-12B structures. In a Complete Initiation Package sent to FWS on January 6, 2015, USACE previously determined that MWD Increment I Field Test may effect, but is not likely to adversely affect, CSSS or its designated critical habitat. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.8.1.2 OPERATIONAL FLEXIBILITY WITHIN ERTP

The USACE will also employ operational flexibility within ERTP to include maximizing flows through S-12 structures from the east to the west as capacity allows. This flexibility will ensure that regulatory releases from WCA-3A are prioritized to the east to the extent practicable to reduce flows into western Shark River Slough where CSSS-A resides. In addition, 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 their current restrictions to further limit flow into western Shark River Slough (refer to **Appendix D**). This flexibility will be used to promote an increased number of consecutive dry days within CSSS habitat as requested by FWS (90 or more consecutive dry days, March 3, 2015 FWS letter) to allow increased potential for breeding. In addition, this flexibility will be used to promote a 90-120 day discontinuous hydroperiod within CSSS habitat.

The 2007 Avian Ecologists Workshop Panel suggested that management actions that increase the number of early broods or maximize success of late-season broods are warranted (Sustainable Ecosystems Institute 2007). To address this recommendation, ERTP multi-agency team defined a specific action objective as improving hydropatterns during the most critical time frames for CSSS survival and breeding (*i.e.* during nest initiation and conditions during the first breeding cycle). To address this objective, the team reexamined the window of concern for sparrow breeding (*i.e.* March 1 to July 15) and adjusted the window to target earlier, and generally more successful, nesting attempts.

Published data and analyses by Baiser et al. (2008) and Virzi et al. (2009), along with input from Dr. Lockwood, (email correspondence to FWS, October 15, 2009) have identified April and May as the most critical time frames for successful CSSS breeding. Based upon intensive nest survey data from CSSS-B and CSSS-E, the CSSS breeding season can be divided into two segments corresponding to different levels of nest success. Prior to June 1, approximately 60% of CSSS nests are successful as compared with approximately 21% after June 1 (Baiser et al. 2008; Boulton et al. 2009a; Virzi 2009; FWS 2010). For the purposes of ERTP, it was assumed that sparrows within CSSS-A experience a similar pattern of nest success, with more successful nesting occurring earlier in the breeding season and a decline in nest success after June 1. Since 2008, intensive nest surveys have been conducted within CSSS-A (Boulton et al. 2009a; Virzi et al. 2009), representing the first time such intensive searching has been performed since 2000 within this subpopulation. Data obtained through their ongoing efforts will be incorporated in future management decisions. Operational changes under ERTP were designed to provide the appropriate hydrologic conditions earlier in the CSSS breeding season when CSSS experience the greatest nest success. Timing of nest initiation and nest success rates were used to better define the most critical portion of the CSSS nesting window on which to base water management decisions.

Timing of nest initiation is thought to be primarily dictated by an internal biological cue rather than habitat conditions, such as water depths (Dr. Lockwood email correspondence to FWS, October 15, 2009). Nott et al. (1998) cited a “10-cm” rule for maximum water depth over which the CSSS will initiate nesting. This conclusion was based upon observations within the range-wide survey in which no singing males were heard when water depths exceeded that level. However, Dean and Morrison (1998) demonstrated that nesting may occur when average water depths exceed this rule. In a 1997 paper, Lockwood et al. (1997) indicated that water depths delay the onset of breeding. However, more recently Dr. Lockwood (email correspondence to FWS, October 15, 2009) stated she believes the internal biological cue is the trigger for nest initiation and she truly does not think water is delaying the start of breeding. As nest initiation is most likely dictated by some internal cue (biological clock) rather than by habitat conditions (*e.g.* water depths), Dr. Lockwood indicated that “just making it drier earlier likely will not free them up to nest any earlier” (email correspondence to FWS, October 15, 2009).

The earliest nest initiation dates identified within the 14-year period between 1996 and 2009 were March 11 through March 15 (Baiser et al. 2008; Virzi 2009). These numbers are based upon intensive nest surveys, primarily in CSSS-B and CSSS-E (**Figure 24**). There is no nest initiation or nest survival data from CSSS-A during IOP time period, with the exception of 2008 and 2009 (Boulton et al. 2009a; Virzi et al. 2009). Research by Dr. Lockwood and her students indicates that the greatest number of nests is initiated between March 25 and April 15, with fewer nests initiated in middle March and June as depicted in **Figure 25**.

ERTP PM-A improves upon FWS RPA by adjusting the breeding window in an attempt to maximize earlier breeding success. The IOP RPA mandated water levels below ground surface level as measured at Gauge NP-205 anytime between March 1 and July 15. For example, under IOP, the 60 day time period potentially could have started as early as March 1 or as late May 15 and FWS RPA would still have been achieved. ERTP mandates water levels below ground surface level (6.0 feet NGVD at NP-205) beginning no later than March 15 for a period of at least 60 consecutive days in order to capture the most successful breeding period of April and May. By mandating March 15 as below ground surface level, there would be a minimum of a two-week window prior to nest initiation for most of the population (Virzi et al. 2009; Virzi 2009), while still meeting water depth requirements for those few birds that may nest earlier (Baiser et al. 2008). In this manner, management actions are aimed at maximizing the number of early broods as recommended by the 2007 Avian Ecologists Workshop Panel.

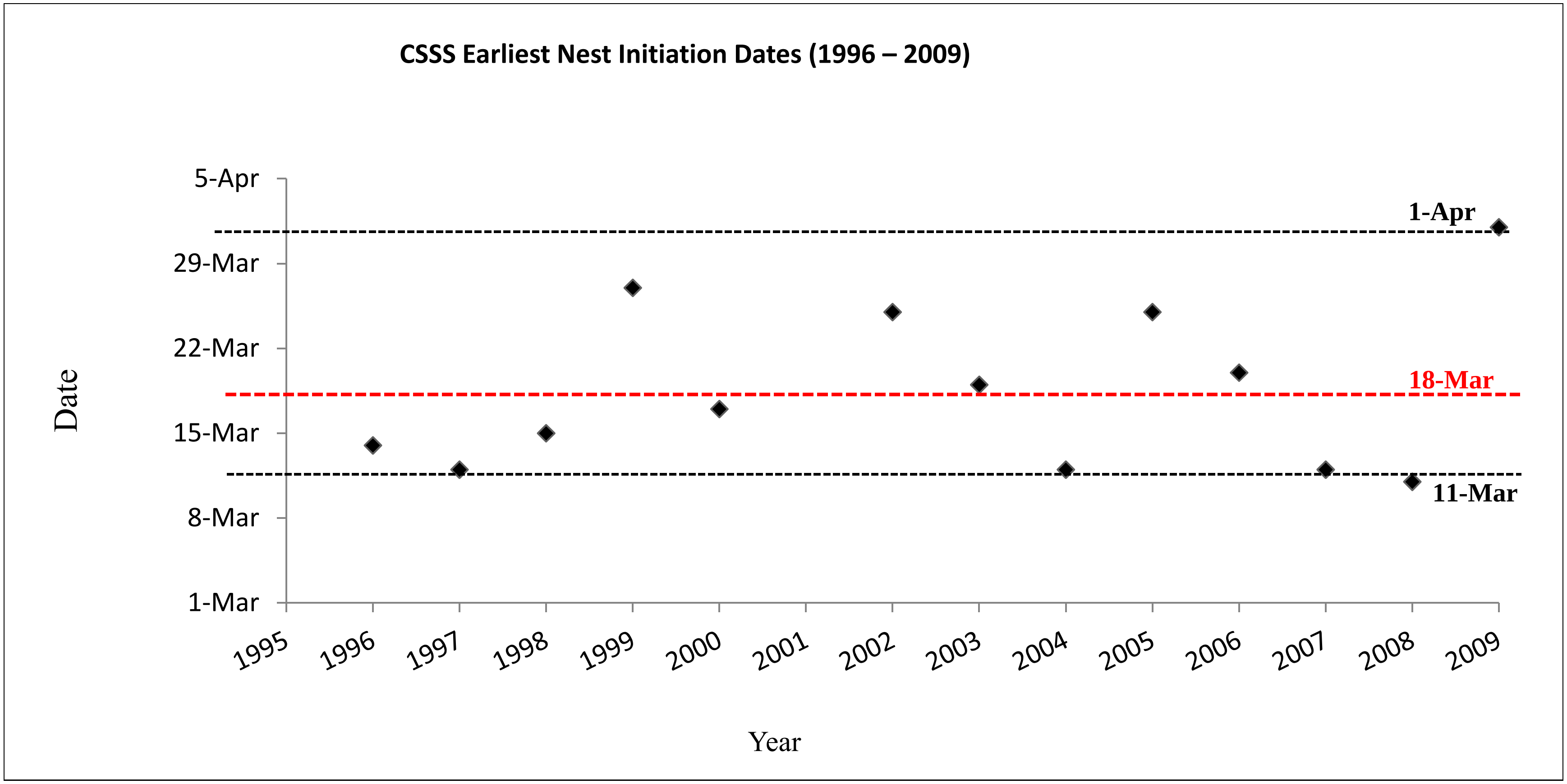


FIGURE 24: EARLIEST CAPE SABLE SEASIDE SPARROW NEST INITIATION DATES BETWEEN 1996 AND 2009

Source: Data and figure courtesy of Virzi (2009)
Note: March 18 represents the average date of nest initiation in March

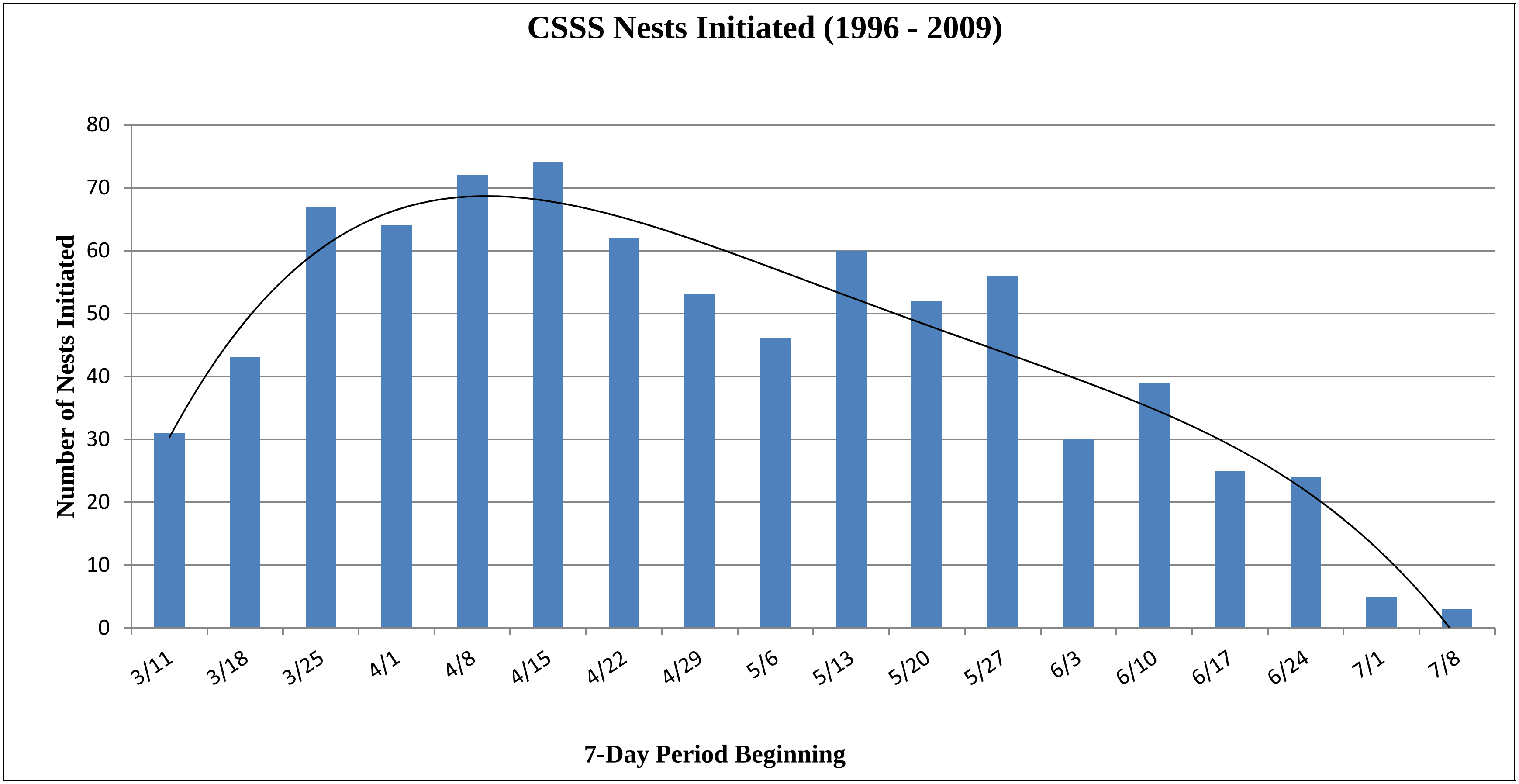


FIGURE 25: NUMBER OF CAPE SABLE SEASIDE SPARROW NESTS INITIATED DURING EACH 7-DAY PERIOD BETWEEN 1996 AND 2009

Source: Data and figure courtesy of Virzi (2009)

During ERTP planning process, it was suggested that a criterion be established to ensure that water depths are below 6.0 feet NGVD at NP-205 by February 15. Based upon Dr. Lockwood's statements (email correspondence with FWS, October 15, 2009), it is unlikely that a February 15 date would trigger earlier breeding as this appears to be determined by an internal biological clock. Requiring water depths to be below ground surface elevation by this date would likely require an earlier closure of S-12A, S-12B, S-343A, S-343B and S-344 (November 1 for S-12A, S-343A, S-343B and S-344), resulting in higher water depths in WCA-3A and less favorable conditions for WCA-3A vegetation and snail kite. There does not appear to be enough scientific data (no data from CSSS-A) to support that water levels below ground surface level by February 15 would promote earlier nesting within CSSS-A and thus benefit the sub-species. In addition, recent research by Virzi and Davis (2013) and Slater et al. (2014), revealed that sparrows in CSSS-B were able to successfully multi-brood in areas with standing water.

Under ERTP, the S12A, S-12B, S343A, S-343B and S-344 structures are mandated to be closed each year until July 15 in order to meet the FWS RPA of a minimum of 60 consecutive dry days as measured at NP-205 between March 1 and July 15. As shown in **Table 4** in many years during IOP and ERTP time periods (2002-2014), S-12A and S-12B structures were opened later than July 15. In eight of the last thirteen years, S-12A opened later than July 15; and in nine of the last thirteen years, S-12B opened later than July 15, allowing on average 26 additional days without flow through S-12A (range 1-101 days); and on average 24 additional days without flow through S-12B (range of 1-57 days).

TABLE 4. COMPARISON OF OPENING/CLOSURE DATES FOR S-12A AND S-12B STRUCTURES, DISCONTINUOUS HYDROPERIOD AND CSSS-A POPULATION ESTIMATES

Calendar Year	S-12A				S-12B				NP-205 Discontinuous Hydroperiod (Days Wet)	Number of Dry Days with CSSS Nesting Window	CSSS-A Population Estimate
	Open	Number of Days post FWS Restricted Opening Date (July 15)	Close	Number of Days post FWS Mandated Closure Date (November 1)	Open	Number of Days post FWS Restricted Opening Date (July 15)	Close	Number of Days prior to FWS Mandated Closure Date (January 1)			
2002		---	1-Nov	0		---	14-Nov	47	273	68	96
2003	22-Jul	7	1-Nov	0	16-Jul	1	1-Jan	0	285	26	128
2004	26-Aug	43	2-Nov	1	27-Aug	44	7-Dec	25	275	79	16
2005	22-Jun	-23	16-Nov	-15	22-Jun	-23	30-Dec	2	230	46	80
2006	24-Aug	41	1-Nov	0	2-Aug	19	4-Nov	57	246	112	112
2007	26-Sep	72	1-Nov	0	4-Oct	80	8-Dec	24	232	25	64
2008	24-Aug	41	2-Nov	-1	17-Jul	2	24-Dec	8	183	160	112
2009	16-Jul	1	29-Oct	2	16-Jul	1	31-Dec	1	255	108	96
2010	15-Jul	0	1-Nov	0	11-Aug	28	2-Dec	30	260	53	128
2011	25-Oct	101	1-Nov	0	25-Oct	101	23-Dec	9	189	117	176
2012	15-Jul	0	2-Nov	-1	15-Jul	0	27-Dec	5	255	66	336
2013	15-Jul	0	2-Nov	-1	15-Jul	0	14-Dec	18	276	54	288
2014	13-Aug	30	1-Nov	0	12-Aug	29	14-Nov	47	248	83	64

With respect to a correlation between structure closures, number of dry days at NP-205 within the nesting period and CSSS population estimates for the following year, there does not appear to be a direct correlation. For example, as shown in **Table 4**, during the 2007 breeding season, S-12A closed November 1, 2006 and remained closed until September 26, 2007 (72 days longer than FWS restricted opening date of July 15). However, during 2007 there were only 25 consecutive dry days measured at NP-205 during the FWS CSSS breeding window of March 1 through July 15. As previously stated, the number of dry days during the breeding season would be reflected in CSSS population estimates the following year, and in 2008, the population estimate for CSSS-A was 112 birds. During the 2008 CSSS breeding season, S-12A closed November 1, 2007 and remained closed until August 24, 2008 In contrast to 2007, in 2008 there were 160 consecutive dry days within FWS CSSS breeding window, but the 2009 CSSS-A population estimate was 96 birds. In contrast to the longer windows without flow through S-12A experienced during 2007 and 2008, during the 2009 CSSS breeding season S-12A closed November 2, 2008 and remained closed until July 16. Despite this shorter window without S-12A flow (as compared with 2007 and 2008), a total of 108 consecutive dry days were measured at NP-205 during FWS CSSS breeding window. The 2010 CSSS-A population estimate was 128 birds. As a final comparison underscoring this apparent lack of direct correlation, during the 2010 CSSS-A breeding season, S-12A closed October 29, 2009 and remained closed until July 15, 2010. During 2010, only 53 consecutive dry days were measured at NP-205 during FWS CSSS breeding window. Despite the shorter breeding window, the 2011 CSSS-A population estimate was 176 birds. This apparent lack of direct correlation underscores the need to investigate alternate sources of water flow within CSSS-A habitat (e.g. western flow, sea level rise), as well as underscores the need for a more holistic approach (e.g. United States Geological Survey Sparrow Tool) to measuring habitat availability within CSSS-A as opposed to the single measurement at NP-205.

The CSSS nesting season is effectively terminated when water levels rise to sufficient depths that result in direct flooding of nests (Lockwood et al. 1997; Nott et al. 1998; Pimm et al. 2002; Baiser et al. 2008). In general, this coincides with the start of the wet season in south Florida. The onset of the wet season shows interannual variability but generally occurs in early June. Nest success after June 1 declines sharply to approximately 21% (Baiser et al. 2008; Boulton et al. 2009a; Virzi 2009; FWS 2010). **Table 5** provides the dates that water first rose above ground level at NP-205 between the years of 2001 and 2009. In eight of the nine years, water depths were above ground surface elevation prior to June 21. In seven of the nine years water depths were above ground prior to June 7. Water depths continued to rise after these dates and did not fall below ground surface level during the remainder of the FWS RPA CSSS nesting window termination date of July 15. Lockwood et al. (1997) reported nest flooding at 14 centimeters and 22 centimeters above ground. The water depths at NP-205 were translated into water depth in centimeters for comparison with the average CSSS nesting height of 17 centimeters.

TABLE 5. DATE AT WHICH WATER DEPTH GREATER THAN 6.0 FEET NGVD AS IS MEASURED AT NP-205 FOR EACH YEAR FROM 2001 TO 2014

Year	First day water depth at NP-205 is > 6.0 feet NGVD	Surface Water Depth (NP-205 Depth- GSE) (feet, centimeters^)
2001	04 June	0.34'; 10.36 cm
2002	21 May	0.19'; 5.79 cm
2003	30 Apr	0.31'; 9.45 cm
2004	6 June	0.26'; 7.92 cm
2005	2 June	0.15'; 4.57 cm
2006	2 July	0.29'; 8.84 cm
2007	2 June	0.18'; 5.49 cm
2008	20 June	0.30'; 9.14 cm
2009	26 May*	0.27'; 8.23 cm
2010	27 April	0.28'; 8.53 cm
2011	26 June	0.12'; 3.66 cm
2012	6 May	0.04'; 1.22 cm
2013	30 April	0.27'; 8.23 cm
2014	25 June	0.02'; 0.61 cm

* No data is available from Gauge NP-205 from January 16, 2009 until May 26, 2009 when NP-205 = 6.13 feet NGVD.

^ CSSS nest on average 17 cm above ground, thus despite surface water conditions, nests may not have been directly flooded.

In general, June 1 also separates first from second clutch attempts. Pimm et al. (2002) have indicated that most pairs must breed at least twice and most nests must be successful (including late-season nests) to allow recovery from population declines. However, low water levels may not be the sole factor necessary for CSSS to multi-brood (Virzi and Davis 2013). Recent research by Virzi and Davis (2013) revealed that 27% of birds within CSSS-B were able to successfully raise a second brood. The researchers also noted that "interestingly, water levels were perhaps highest in subpopulation B throughout most of the breeding season and sparrows were able to multi-brood despite the high water levels" (Virzi and Davis 2013). Virzi and Davis (2013) speculate that other factors such as an unrecognized Allee effect in small sparrow subpopulations (e.g. CSSS-A) may be leading to a lack of multi-brooding. Further research is needed to better understand this trend. Although water levels were above the ground surface by mid to late June in the majority of IOP/ERTP years, the July 15 structural opening date for S12A-B, S-343A-B and S-344 structures will remain unchanged. In addition, USACE will utilize the existing operational flexibility inherent within ERTP to delay opening of the structures when conditions permit (refer to **Table 4**, **Figure 5**, **Figure 6**). By maintaining the July 15 opening date along with delaying opening of the structures as conditions permit, there is potential for multiple CSSS broods and potential for recovery from population declines. Therefore, USACE has concluded that continued implementation of ERTP will not significantly impact late season nesters within CSSS-A.

In a letter dated December 12, 2014, FWS provided an assessment of operations within the C-111SD Project area to include detention cells and project components of the CERP C-111 Spreader Canal Western Project. Operations of the CERP C-111 Spreader Canal Western Project are currently under the sole operation of SFWMD under an FDEP and USACE Regulatory Permit. These operations are governed by a separate ESA consultation and FWS BO. In addition, any adjustments to the operation of the CERP C-111 Spreader Canal Western Project may require modifications to existing permits. Finally, USACE 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. Until completion of construction of the C-111 SD Project components (e.g. Northern Detention Area) is complete, USACE is not proposing any operational changes outside the existing ERTP flexibility. However, as previously stated, USACE will work cooperatively with FWS and SFWMD to promote recommended hydrological conditions within eastern CSSS subpopulations. Through implementation of a coordinated water management operational decision making process for use of the S-332B, S-332C and S-332D structures, USACE anticipates that prioritization of pumping at these structures will benefit eastern CSSS subpopulations.

Finally, ERTP 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. 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 S-12 and S-333 structures to create storage within WCA-3A. 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. 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. This flexibility may result in an increased opportunity for nesting within CSSS-A.

5.5.8.1.3 WATER FLOW ANALYSIS TEST

The proposed Water Flow Analysis Test will allow for a better understanding of directionality of flow entering CSSS-A habitat to determine whether additional operational modifications to the S-12A, S-12B, S-343A, S-343B and S-344 structures or other additional measures may be needed to prevent western flows into CSSS-A. Implementation of the Water Flow Analysis Test will not directly affect CSSS residing within western Shark Slough. The Water Flow Analysis Test may require additional flow or parameter sampling meters and/or additional monitoring gauges within ENP. The USACE will obtain all necessary permits including those from the National Park Service in order to implement this test. USACE has concluded that implementation of the Water Flow Analysis Test may affect, but is not likely to adversely affect, CSSS. USACE expects that results from the test will provide direct benefits to CSSS by identifying adverse flows and identifying additional reasonable and prudent measures to reduce any negative effects to this subspecies.

5.5.8.1.4 L-28 BORROW CANAL

During consultation with FWS and BCNP, it was suggested that the L-28 Borrow Canal is responsible for direct delivery of water flow into western CSSS-A. Since western flows have been suggested as having an adverse effect on CSSS-A, particularly within its western region, USACE will prepare an assessment, using an interagency team, of potential effects of Levee 28 (L-28) Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, USACE 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 multiagency team to include FWS, 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. This effort will require authorization, NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of L-28 Borrow Canal options within this Supplemental Biological Assessment. Since at this point this is solely a planning study, USACE has concluded that L-28 Borrow Canal Planning Study will have no effect on CSSS. However, USACE expects that the results of the planning effort will identify reasonable and prudent measure(s) that will directly benefit CSSS, particularly CSSS-A.

5.5.8.2 CAPE SABLE SEASIDE SPARROW SPECIES EFFECT DETERMINATION

Section 7(a) (2) of the Endangered Species Act provides as follows:

> Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an “agency action”) is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available.

In accordance with the Terms and Conditions contained within the 2010 ERTP BO, USACE is required to provide an annual assessment of ERTP operations. As previously stated, this annual assessment includes a summary of PSC, analysis of incidental take, analysis of ERTP performance measures and ecological targets and species monitoring. In the Water Year 2014 Annual Assessment (October 1, 2013 through September 30, 2014) (Annex B), it was determined that an Incidental Take Reinitiation Trigger for CSSS was met. The 2014 ENP range-wide CSSS survey revealed a population estimate of approximately 2,720 birds (**Table 3**). As this number is lower than the reinitiation trigger of 2,915 birds, USACE concluded that reinitiation of consultation based upon this trigger and requirements of the 2010 ERTP BO was required at this time.

In addition to the USACE November 17, 2014 reinitiation request, USACE also completed a retrospective review of ERTP operations during the 2013 nesting season as operations during this period would have the potential for the greatest impact on population estimates for the following (*i.e.* 2014) breeding season. According to the 2014 CSSS survey, only 4 singing males were encountered within CSSS-A as compared with 18 singing males in 2013.

During the 2013 CSSS nesting season, S-12A, S-12B, S-343A, S-343B and S-334 were closed as per their individual mandated requirements in the 2012 ERTP FEIS. The ERTP was designed to protect CSSS to the maximum extent possible through water management operations, while providing for the needs of multiple species within the greater Everglades. Implementation of ERTP resulted in continuation of 2006 IOP closure periods for the aforementioned structures. The purpose of closure periods was to provide an improved opportunity for nesting within CSSS-A by maintaining water levels below ground level for a minimum of 60 consecutive days between March 1 and July 15, corresponding to the CSSS breeding season. This 60-day minimum requirement was developed by FWS as a reasonable and prudent alternative resulting from the 1999 Jeopardy BO. It is important to note that neither ERTP nor IOP were designed to facilitate recovery of this subspecies, but as measures to minimize potential effects of water management operations on this subspecies during the breeding season. ERTP Operations were implemented in October 2012.

During Water Year 2013 (October 2012 through September 30, 2013), the S-12A, S-343A/B and S-344 structures were closed November 1, 2012 in accordance with 2012 ERTP. The S-12B structure closed December 26, 2013, in accordance with the WCA-3A Rainfall-Based Management Plan, 6 days prior to its mandated closure date of January 1, 2013. Although S-12C does not have any mandated closure periods for protection of CSSS under ERTP, this structure closed January 12, 2013 in accordance with the WCA-3A Rainfall-Based Management Plan and remained closed until May 6, 2013 (**Appendix B**). Stage data from NP-205 indicate that water was below ground surface level as early as February 4, 2013 and remained below ground surface elevation until April 23, 2013, a period of 78 days. Within the FWS-defined CSSS breeding window of March 1 through July 15, a total of 54 days of continuously dry conditions were experienced at NP-205. FWS has asserted that it takes approximately 45 days to complete one brood cycle; however, a greater number of dry days (80-120) could potentially allow multiple broods. Although there is a potential for multiple broods, research has suggested that most successful reproduction occurs prior to June 1 (Baiser et al. 2008; Boulton et al. 2009a; Virzi 2009; FWS 2010). In addition, based upon stage data recorded at NP-205 within CSSS-A, water stages were above ground elevation in April 2013 potentially prohibiting CSSS nesting within some areas, thereby further limiting breeding success after June 1. However, it is important to note the recent evidence from Virzi and Davis (2013) which indicated that low water levels may not be the sole factor necessary for CSSS to multi-brood. In fact, CSSS-B had the highest water levels when compared with CSSS-A and CSSS-D and sparrows in CSSS-B were able to successfully raise a second brood despite the high water levels. It is also interesting to note that the most successful birds were actually nesting in dense sawgrass in CSSS-B (Virzi and Davis 2013).

Similarly, during the 2014 CSSS nesting season, S-12A, S-12B, S-343A, S-343B and S-334 were closed as per their individual requirements in 2012 ERTP FEIS (**Appendix A**). During Water Year 2014 (October 1, 2013 through September 30, 2014), the S-12B structure closed December 13, 2013, 18 days prior to the mandated ERTP closure date of January 1, 2014. The structure closed based upon WCA-3A Rainfall-Based Management Plan. Although S-12C does not have any mandated closure periods for protection of CSSS under ERTP, this structure also closed December 13, 2013 in accordance with the WCA-3A Rainfall-Based Management Plan. Stage data from NP-205 indicate that water was below ground surface level as early as March 4, 2014, however, there were fifteen non-consecutive days during the period between March 4 and April 3, 2014 in which there was a change from groundwater to surface water conditions. During this time period (*i.e.* March 4 to April 3, 2014) a total of 3.74 inches of rainfall was measured at NP-205 with 1.95 inches measured in a single day (March 25, 2014). The rise in water level equated to between 0.07 to 4.58 centimeters in water depth above ground surface level as measured at NP-205. Water depths experienced during these reversals could potentially affect CSSS-A nesting due to differences in microtopography within CSSS-A habitat, however, CSSS nest heights average approximately 17 cm above ground surface elevation, therefore some nests within CSSS-A may not have been adversely affected by the transition to surface water conditions. If this time frame (March 4-April 3, 2014) is included within the number of days in which conditions were suitable for nesting, a total of 113 days during the CSSS nesting window of March 1 until July 15 would have been achieved during Water Year 2014. In addition, the S-12A, S-12B, S-343A, S-343B and S-344 structures remained closed until August 12, 2014, thereby further limiting flow into CSSS-A and thus allowing for the potential for multiple broods. Since the S-12A, S-12B, S-343A, S-343B and S-344 structures were all closed in accordance with 2012 ERTP FEIS and significant rainfall was experienced at NP-205 in March, USACE concluded that water releases did not contribute to the transition from groundwater to surface water at NP-205 during Water Year 2013 or Water Year 2014. Based upon recent research by Virzi and Davis (2013) and Slater et al. (2014), low water levels may not be the sole factor necessary for sparrows to multi-brood.

During the USACE and FWS consultation for CEPP, a number of items were discussed that could facilitate CSSS recovery. During this consultation, FWS noted the need for a better survey methodology and population estimator to more accurately assess CSSS population size (FWS 2014). In addition, in a recent conversation with ENP personnel, it was reported that there were apparent anomalies with CSSS ENP range-wide survey data and in particular, with negative data. Anomalies with the negative data center around the concern that the database does not discern between sites apparently surveyed in which birds were not encountered versus sites that were never surveyed. This anomaly (among others) would affect the accuracy of data reported, thus calling into question the information that was used to establish the Incidental Take trigger within the 2010 ERTP BO. The ENP indicated that they are in the process of performing a quality assessment/quality control review of the entire database to ensure accuracy. This effort is expected to be completed within 2015 and will assist to provide a more accurate accounting of survey data.

As shown in **Table 3**, CSSS-A has not recovered under IOP/ERTP operations, but has remained relatively stable since IOP/ERTP implementation in 2002. There are several factors that influence population size including competition, predation and prey availability; recent research suggests that sparrow populations are slow to recover, or cannot recover, once they reach very small population sizes due to low adult and juvenile recruitment, many unmated males, biased sex ratios, lower hatch rates and other adverse effects associated with small population size (*i.e.* the Allee effect) (Boulton et al. 2009a; Virzi et al. 2009). Virzi and Davis (2013) assert that there may be an unrecognized Allee effect within small CSSS subpopulations that may account for lack of multi-brooding and hypothesize it may be due to a lack of conspecific cues. Predation pressure within CSSS-A may also be a factor limiting recovery (Virzi and Davis 2013; Slater et al. 2014). Further investigation is necessary to better understand the lack of recovery. In addition, ENP has been identified as a hotspot for methylmercury. Methylmercury has been shown to have sub-lethal effects on songbirds resulting in reduced reproductive success (Jackson et al. 2011). Since CSSS feed on insects, including spiders, dietary uptake of mercury is a concern. In a recent study with Carolina wrens, Jackson et al. (2011) found a 34% reduction in nesting success on mercury-contaminated sites when compared with reference sites. In addition, their analyses consistently ranked mercury contamination as a leading predictor of nest success, more than any other factor evaluated.

CSSS-B is the largest of the subpopulations and due to its location downstream of the elevated pine rocklands is relatively well protected from managed water releases under IOP and ERTP operations. Consequently, continued implementation of ERTP operations would not alter any of the primary constituent elements within CSSS Critical Habitat Unit 1 or affect the status of CSSS-B. As shown in **Table 3**, CSSS-B was not surveyed in 2008 or 2009; thus CSSS-B population size for 2007 was used to calculate the total CSSS population size in 2008 and 2009. Similarly, CSSS-B was also not surveyed in 2011 or 2012 and CSSS-B population size in 2010 was used to calculate the total CSSS population size in 2011 and 2012. Based upon the actual survey data from 2007 and 2010 (**Table 3**), CSSS-B was estimated at 2,512 birds and 1,904 birds, respectively, equating to an apparent decline in CSSS-B of 608 birds between 2007 and 2010. In addition, CSSS-B also showed another apparent decline of 112 birds between 2010 (1,904 birds) and 2013 (1,792 birds). As the largest of the subpopulations, CSSS-B contributes the largest percentage of birds to the total CSSS population size. These apparent declines cannot be attributed to IOP/ERTP water management operations and would account for the exceedance of the ERTP CSSS reinitiation trigger. Additionally recent research has shown that birds within CSSS-B have been successfully able to multi-brood in areas of dense sawgrass with standing water, leading one to the conclusion that dry conditions may not be the only limiting factor in other subpopulations (Virzi and Davis 2013; Slater et al. 2014). It also underscores the assertion that factors other than water management operations influence CSSS population size.

USACE concludes that its water management operations are not likely to jeopardize the continued existence of any endangered species or threatened species, including CSSS or result in the destruction or adverse modification of habitat. USACE will continue to manage water flows into CSSS habitat to minimize the possibility of inundation during the critical nesting period. Such action would not contribute to further reduction of the population due to flooding of nests during the CSSS breeding season and would not cause adverse modification of habitat. USACE will work diligently with FWS to identify additional reasonable and prudent measures to further minimize effects on this subspecies.

5.5.8.3 CAPE SABLE SEASIDE SPARROW CRITICAL HABITAT

Critical habitat for the CSSS was designated on August 11, 1977 (42 FR 42840) and revised on November 6, 2007 (72 FR 62735 62766). Currently, the critical habitat includes areas of land, water and airspace in the Taylor Slough vicinity of ENP in Miami-Dade and Monroe counties, Florida. Primary constituent elements include suitable soil, vegetation, hydrologic conditions and forage base. The designated area encompasses approximately 156,350 acres (63,273 hectares) and includes portions of CSSS-B through CSSS-F (**Figure 12**). CSSS-A is the only area occupied by sparrows that does not have associated designated critical habitat.

Because the majority of designated critical habitat lies within ENP, there have been relatively few impacts. However, about 471.5 acres (190.8 hectares) of critical habitat were altered during construction of the S-332 B detention areas and a portion of the B-C connector. No other permanent alteration of critical habitat is known. Degradation of critical habitat has resulted from flooding within the area of CSSS-D, and frequent fires and woody vegetation encroachment in overdrained areas near CSSS-C and CSSS-F. Degradation of these habitats is not permanent, and they may improve through restoration efforts.

The C-111 Spreader Canal Western Project has the potential to affect up to approximately 1,606 acres of habitat within Critical Habitat Unit 3 (CSSS-D). In an average year, Unit 3 would experience extended hydroperiods across 1,606 acres in an average year and 1,421 acres in a wet year. Increased hydroperiods are anticipated to degrade primary constituent element 2 (see description below) by potentially altering the vegetative density or diversity of preferred grasses used by CSSS. However, the changes are not expected to be so severe as to eliminate the preferred grass species (PCE 2) across this acreage in Unit 3. Therefore, the functions for which Critical Habitat Unit 3 was designated for the conservation of the species would not be appreciably altered. USACE notes that C-111 Spreader Canal Western Project is covered under a separate BO and Terms and Conditions are implemented by SFWMD.

In order to predict the action related effects on CSSS, one must consider those physical and biological features that are essential to the conservation of the species, and their habitat. These include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, and rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. These requirements, which are based on the biological needs of this species, are described in the final critical habitat designation published in the Federal Register on 6 November 2007 (FR Vol. 72, No. 214).

Primary constituent elements are physical and biological features that have been identified as elements essential to the conservation of the species. As described in the Federal Register (FR Vol. 72, No. 214), the primary constituent elements include:

- Soils that are widespread in the Everglades' short-hydroperiod marshes and support the vegetation types that the CSSS rely on;
- Plant species that are characteristic of CSSS habitat in a variety of hydrologic conditions that provide structure sufficient to support CSSS nests, and that comprise the substrate that CSSS utilize when there is standing water;
- Contiguous open habitat because CSSS require large, expansive, contiguous habitat patches with sparse woody shrubs or trees;

- Hydrologic conditions that would prevent flooding sparrow nests, maintain hospitable conditions for CSSS occupying these areas, and generally support the vegetation species that are essential to CSSS; and
- Overall the habitat features that support the invertebrate prey base the CSSS rely on and the variability and uniqueness of habitat.

Evaluations of action effects to the primary constituent elements are discussed below:

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 CSSS depend. Presently, soils in the marl prairie landscape within CSSS habitat vary in physical and chemical characteristics due to the variation in topography, hydrology, and vegetation (Sah et al. 2007). Alteration of soil characteristics due to action operations would be difficult to detect in the short term.

HERBACEOUS VEGETATION

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, black sedge, and cordgrass (*Spartina bakeri*). These plant species are largely characteristic of areas where CSSS occur. They act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Although many other herbaceous plant species also occur within CSSS habitat (Ross et al. 2006), and some of these may have important roles in the life history of the CSSS, the species identified in the primary constituent relationship consistently occur in areas occupied by sparrows (Sah et al. 2007). With a trend indicating longer hydroperiods affecting the vegetative community composition in CSSS critical habitats, it may be difficult to separate action level effects from other factors (e.g. sea level rise).

CONTIGUOUS OPEN HABITAT

CSSS subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. The components of this primary constituent element 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 CSSS. Implementation of the proposed action could extend hydroperiods causing a minimal effect on the occurrence of natural fires in the area. The proposed water management strategy, however, is designed to control excessive hydroperiods thus minimizing significant changes in vegetative composition.

HYDROLOGIC REGIME-NESTING CRITERIA

As stated, favorable nesting habitat requires short hydroperiod vegetation characteristic of mixed marl prairie communities. A measure of the potential for CSSS nesting success is the number of consecutive days between March 1 and July 15 that water levels are below ground surface. Preferable discontinuous hydroperiod durations range from 60 to 180 days, although a 40 to 80 consecutive day period is considered favorable (Pimm et al. 2002).

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 centimeters) more than 30 days during the period from March 15 to June 30 at a frequency of more than two out of every ten years. Water depths greater than 7.9 inches (20 centimeters) during this period will 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, CSSS may be able to re-nest within the same season. These depths, if they occur for sustained periods (more than 30 days) within CSSS nesting season, will reduce successful nesting to a level that will be insufficient to support a population if they occur more frequently than two out of every ten years. This has occurred within portions of the CSSS range.

5.5.8.4 POTENTIAL EFFECTS TO CAPE SABLE SEASIDE SPARROW CRITICAL HABITAT

CRITICAL HABITAT UNIT 1/CSSS-B

As shown in **Table 3**, Critical Habitat Unit 1 represents the largest CSSS subpopulation and has remained relatively stable since implementation of IOP operations in 2002. Wet prairie vegetation predominates within this unit (Ross et al. 2006). Due to its location downstream of the elevated pine rocklands, Unit 1 is relatively well protected from the managed water releases under IOP. Consequently, continued implementation of ERTP and associated reasonable and prudent measures are not expected to alter any of the primary constituent elements within Unit 1 or affect the status of CSSS-B.

CRITICAL HABITAT UNIT 2/ CSSS-C

Habitat of varying suitability occurs within Unit 2. Long-hydroperiod marshes occur south of the S-332 pumping station, while areas to the north are overdrained and prone to frequent fires. The most recent fire occurred in March 2007 when the Frog Pond fire swept through this area. The habitat has yet to fully recover (Sah et al. 2008, Virzi et al. 2009). The variable habitat conditions are thought to be a consequence of the 1980 construction of the S-332 pumping station, located at the boundary of ENP and Taylor Slough. Unit 2 holds relatively few CSSS (**Table 3**). 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%. Previous research has indicated that habitat is unsuitable for CSSS for two to three years after it burns, so intensive nest surveys in 2010 within this subpopulation may reveal changes in utilization by sparrows. Recent research has indicated that within Unit 2, CSSS-C is suffering from the ill-effects of small population size including fewer breeding individuals, male-biased sex ratios, lower hatch rates, and lower juvenile return rates (Boulton et al. 2009a; Virzi et al. 2009). Please refer to **Appendix B** for the 2013 and 2014 Annual Assessments for further evaluation of CSSS designated critical habitat.

CRITICAL HABITAT UNIT 3/CSSS-D

Since 1981, when an estimated 400 CSSS resided within Unit 3, this subpopulation has experienced a continual decline in population size (**Table 3**; Cassey et al. 2007). CSSS-D is a small, dynamic subpopulation that fluctuates annually, occupancy within Unit 3 is low and detection probability is highly variable. Thought to be functionally extirpated in 2007 (Lockwood et al. 2008), CSSS were again encountered within this area in 2009 when Virzi et al. (2009) encountered four males and two females. In 2013, Virzi and Davis (2013) documented three males and two females. Vegetation within this critical habitat unit is largely unsuitable for CSSS breeding. Since 2000, high water levels and longer hydroperiods have prevailed resulting in a sawgrass-dominated community interspersed with patches of muhly grass at higher elevations (Ross et al. 2003). Please refer to **Appendix B** for the 2013 and 2014 Annual Assessments for further evaluation of CSSS designated critical habitat.

CRITICAL HABITAT UNIT 4/CSSS-E

Located along the eastern edge of Shark River Slough, Critical Habitat Unit 4 encompasses approximately 66 square kilometers. The Rocky Glades separate Unit 4 and CSSS-E from the other eastern subpopulations. Unit 4 holds the second greatest number of CSSS among all subpopulations. Due to its location (**Figure 12**), Unit 4 is relatively well protected from the managed water releases that occurred under IOP. Implementation of ERTP is not anticipated to produce impacts to Unit 4. Please refer to **Appendix B** for the 2013 and 2014 Annual Assessments for further evaluation of CSSS designated critical habitat.

CRITICAL HABITAT UNIT 5/CSSS-F

The most easterly of all CSSS critical habitat units, Unit 5 is located at ENP boundary in proximity to agricultural and residential development. Habitat within this critical habitat unit suffers from over-drainage, reduced water flow, exotic tree invasion and frequent human-induced fires (Lockwood et al. 2003; Ross et al. 2006). To alleviate the perpetual drier conditions and its associated problems, increased water flows within this area are required. Unit 5 consists of approximately 14 square kilometers and thus is the smallest of all the units. Recent surveys have detected few or no CSSS within this unit (**Table 3**). Please refer to **Appendix B** for the 2013 and 2014 Annual Assessments for further evaluation of CSSS designated critical habitat.

5.5.8.5 CAPE SABLE SEASIDE SPARROW CRITICAL HABITAT DETERMINATION

The 1999 FWS RPA stated that in addition to the 60-day dry nesting constraint the USACE would have to ensure that 30%, 45%, and 60% of required regulatory releases crossing Tamiami Trail enter ENP east of the L-67 Extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that meet or exceed those produced by the 30%, 45%, and 60% targets; and produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase II operations (USACE 1995). These IOP RPA conditions would continue to be met under ERTP.

Under IOP/ERTP, water is routed from WCA-3A through the S-333 and S-334 structures into south Miami-Dade County to improve hydrological conditions within Critical Habitat Units 2, 3 and 5. IOP operations have produced longer hydroperiods and more natural hydrologic regimes within the eastern marl prairies occupied by CSSS-C, CSSS-E and CSSS-F. Effects of IOP/ERTP operations on Unit 4 have been relatively small and are expected to continue to be minor under implementation of ERTP. Therefore, continued implementation of ERTP and associated reasonable and prudent measures are not expected to alter the status of CSSS-E or its designated critical habitat.

IOP/ERTP operations have improved the hydrologic and habitat conditions within Unit 2. Through a reduction of seepage out of ENP, use of S-332 Detention Areas has lessened the overdrying of potential CSSS habitat within Unit 2 (CSSS-C) and Unit 5 (CSSS-F). The operations of these features were predicted to reduce the risk of damaging wildfires, reduce encroachment by woody vegetation and result in a more natural response to rainfall events. CSSS-C is the only subpopulation to shows signs of recent recovery (Cassey et al. 2007). Pump limitations on S-332D between February 1 and July 15 (or the end of the CSSS nesting season as determined by FWS) increased from 165 cfs under IOP to 250 cfs under ERTP. Field data from the Experimental Program and data from 2008 and 2009 (SFWMD, unpublished data) reveal that currently a volume of water equivalent to approximately half of the flow pumped into S-332D flows as seepage to the C-111 Canal. With approximately half of the water pumped flowing to C-111 as seepage, limiting S-332D discharges to 165 cfs resulted in considerably less water reaching Taylor Slough than when S-174 and S-332 were used (SFWMD, unpublished data). Based upon observed data during 2013 and 2014 (*i.e.* implementation of ERTP), USACE has determined that increased pumping at S-332D has not had a significant effect on Unit 2 and continued ERTP implementation will continue to provide benefits to Unit 2 (**Appendix B**).

IOP/ERTP operations, however, have not produced the desired effects within Unit 5. Very few birds have been detected by the range-wide survey since IOP implementation and no CSSS were encountered in 2007, 2008 or 2009 (**Table 3**). In 2008, the Mustang Corner fire swept through this unit devastating large areas of sparrow habitat. Research has shown that burned prairies are unsuitable for sparrows for approximately two years after the fire (Pimm et al. 2002; Lockwood et al. 2005; La Puma et al. 2006); and frequent fires within shorter hydroperiod wet prairies will exclude use of the habitat by CSSS (Curnutt et al. 1998). Increased water flows are required within this area to alleviate dry condition and help prevent future wildfires. Continued implementation of ERTP has the potential to slightly improve the hydroperiod within Unit 5, however, the extent of this effect and its benefits to CSSS-F are uncertain. It is anticipated with reprioritization of pumping at the S-332B, S-332C and S-332D, some additional benefits may be realized within CSSS-F, but this remains to be determined based upon implementation.

Long hydroperiods leading to growth of marsh vegetation within Unit 3 (CSSS-D) have precluded the recovery of CSSS within this area. Over the eight years of IOP operations, there was little impact on hydrological conditions within this area. Results of SFWMM indicated that ERTP implementation would not significantly reduce the hydroperiods within Unit 3 that were observed under IOP. It is important to note that the C-111 Spreader Canal Western Project was predicted to increase groundwater levels within Unit 3. Thus the extent of hydrological alteration within Unit 3 due to continued implementation of ERTP is uncertain, but likely to be minimal. It is important to note that operations of C-111 Spreader Canal Western Project are governed by an FDEP and USACE Regulatory permit as well as a FWS BO. SFWMD is responsible for operation of C-111 Spreader Canal Western Project features.

Based on an evaluation of impacts to the primary constituent elements identified as essential to the conservation of the species, continued implementation of ERTP and associated reasonable and prudent measures could establish hydrological changes that may alter some of the physical and biological features within designated Critical Habitat Units 2, 3, and 5 of the CSSS. Continued implementation of ERTP may affect vegetation within designated critical habitat through hydrological changes that increase hydroperiods within the eastern marl prairies within subpopulations C and F. Increased use of the SDA may act to decrease hydroperiods within Unit 3, an area that has suffered in the past from extended hydroperiods leading to a transition in vegetation from muhly grass to sawgrass (Ross et al. 2004, Virzi et al. 2009). Although anticipated modifications are expected to be minimal and are not expected to appreciably diminish the value of critical habitat, USACE has determined that the proposed action may affect designated critical habitat.

5.5.9 SNAIL KITE AND “MAY EFFECT” DETERMINATION

A wide-ranging, New World raptor, the snail kite (*Rostrhamus sociabilis*) is found primarily in lowland freshwater marshes in tropical and subtropical America from Florida, Cuba, and Mexico, and south to Argentina and Peru (FWS 1999). The Florida and Cuban subspecies of snail kite, *R. sociabilis plumbeus,* was initially listed as endangered in 1967 due to its restricted range and highly specific diet (FWS 1999). Its survival is directly tied to the hydrology, water quality, vegetation composition and structure within the freshwater marshes that it inhabits (Martin et al. 2008; Cattau et al. 2008).

Snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lakes where the apple snail (*Pomacea paludosa*), the snail kite’s main food source, can be found. Snail kite populations in Florida are highly nomadic and mobile; tracking favorable hydrologic conditions and food supplies, and thus avoiding local droughts. Snail kites move widely throughout the primary wetlands of the central and southern portions of the State of Florida. The snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once snail kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth, which inhibits the snail kite’s ability to see its prey (FWS 1996).

The snail kite has a highly specialized diet typically composed of apple snails, which are found in palustrine, emergent, long-hydroperiod wetlands. As a result, the snail kite’s survival is directly dependent on the hydrology and water quality of its habitat (FWS 1999). Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Suitable foraging habitat for the snail kite is typically a combination of low profile marsh and a mix of shallow open water. Shallow wetlands with emergent vegetation such as spike rush (*Eleocharis* spp.), maidencane, sawgrass, and other native emergent wetland plant species provide good snail kite foraging habitat as long as the vegetation is not too dense to locate apple snails. Dense growth of plants reduces the ability of the snail kite to locate apple snails and their use of these areas is limited even when snails are in relatively high abundances (Bennetts et al. 2006). Areas of sparse emergent vegetation enable apple snails to climb near the surface to feed, breathe, and lay eggs and thus they are easily seen from the air by foraging snail kites. Suitable

foraging habitats are often interspersed with tree islands or small groups of scattered shrubs and trees which serve as perching and nesting sites.
Historically, snail kites have fed almost exclusively on Florida apple snail (*Pomacea paludosa*). However, many wetlands utilized by snail kite have become invaded by an exotic apple snail (*P. maculata*). Where exotic apple snails have colonized, their densities are often 2 to 100 times greater than the native apple snail (Karunaratne et al. 2006; Pias et al. 2012; Darby et al. 2012; Fletcher et al. 2015). Anecdotal evidence as well as results from Darby et al. 2012, Therrien et al. 2014, Fletcher et al. 2015 and others suggests that snail kites are actively foraging on exotic apple snails and areas of high densities of exotic apple snails support higher numbers of snail kites. Fletcher et al. (2015) noted that there is little support that snail kites are preferentially choosing snails based upon species and that when exotic snails are selected, snail kites chose medium sized snails (size range of 50-65 mm in length. Further research is needed to determine how the advance of exotic apple snails may affect snail kite population demographics and long term sustainability of the population.

Snail kite nesting primarily occurs from December to July, with a peak in March-June, but can occur year-round. Nesting substrates include small trees such as willow, cypress (*Taxodium* spp.) and pond apple, and herbaceous vegetation such as sawgrass, cattail, bulrush (*Scirpus validus*) and reed (*Phragmites australis*). Snail kites appear to prefer woody vegetation for nesting when water levels are adequate to inundate the site (FWS 1999). Nests are more frequently placed in herbaceous vegetation during periods of low water when dry conditions beneath willow stands (which tend to grow to at higher elevations) prevent Snail kites from nesting in woody vegetation (FWS 1999). Nest collapse is rare in woody vegetation but common in non-woody vegetation, especially on lake margins (FWS 1999). In order to deter predators, nesting almost always occurs over water (Sykes 1987a; Sykes et al. 1995).

Snail kites construct nests using dry plant material and dry sticks, primarily from willow and wax myrtle (Sykes 1987a), with a lining of green plant material that aids in incubation (FWS 1999). Courtship includes male displays to attract mates and pair bonds form from late November through early June (FWS 1999). Snail kites will lay between one and five eggs with an average of about three eggs per nest (Sykes 1987b; Beissinger 1988; Snyder et al. 1989). Each egg is layed at about a two-day interval with incubation generally commencing after the second egg is laid (Sykes 1987b). Both parents incubate the eggs for a period of 24 to 30 days (Beissenger 1987). Hatching success is variable between years and between watersheds, but averages 2.3 chicks/nest (FWS 1999; Cattau et al. 2008). February, March and April have been identified as the most successful months for hatching (Sykes 1987b). Snail kites may nest more than once within a breeding season and have been documented to renest after both failed and successful nesting attempts (Sykes 1987b; Beissinger 1988; Snyder et al. 1989). Chicks are fed by both parents through the nestling period although ambisexual mate desertion has been documented (FWS 1999). Young fledge at approximately 9 to 11 weeks of age (Beissenger and Snyder 1987; Beissenger 1988). Adults forage no more than 6 kilometers from the nest, and generally less than a few hundred meters (Beissenger and Synder 1987; FWS 1999). When food is scarce or ecological and hydrological conditions are unfavorable, adults may abandon the nest altogether (Sykes et al. 1995).

The snail kite occupies the watersheds of the Everglades, Kissimmee River, Caloosahatchee River, the upper St. Johns River, and Lake Okeechobee. According to the FWS (1999), "Each of these watersheds has experienced, and continues to experience, pervasive degradation due to urban development and agricultural activities." The Snail kite's dependence upon each of these watersheds has shifted significantly over the last decade. Lake Okeechobee and WCA-3A, once important snail kite foraging and nesting areas, no longer support high densities of snail kites. 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. This loss of suitable habitat and refugium, especially during droughts, may have significant demographic consequences (Takekawa and Beissinger 1989; Kitchens et al. 2002; Martin et al. 2006a). Between the period of 1996 and 2010, Lake Okeechobee only made minor contributions to the snail kite population in terms of reproduction (Cattau et al. 2008). The loss of suitable snail kite foraging and nesting areas within Lake Okeechobee have been attributed to shifts in water management regimes (Bennetts and Kitchens 1997), along with habitat degradation due to hurricanes (Cattau et al. 2008). Since 2010, snail kites have once again started to nest on Lake Okeechobee in part due to changes in Lake Okeechobee water management operations leading to increases in the spatial extent of optimal habitat and proliferation of exotic apple snails within the Lake. In 2013, Lake Okeechobee was the most productive water body through the snail kite range in terms of successful snail kite reproduction and was the second most productive water body in 2014 (Fletcher et al. 2015).

Historically, WCA-3A has been a critical component within the snail kites' wetland network for foraging and reproduction. Reproductive effort and success in WCA-3A decreases sharply after 1998 (Martin et al. 2008) and no young fledged from WCA-3A in 2001, 2005, 2007, 2008 or 2010. Changes in water management regimes have contributed to the lack of reproduction within this critical habitat area (Mooij et al. 2002; Zweig and Kitchens 2008; Cattau et al. 2008, 2009). These changes will be discussed in detail as related to the ERTP modifications to IOP water management operating regime to specifically improve conditions for foraging and nesting snail kites in WCA-3A. ERTP operations were implemented in October 2012, thus there have been two snail kite breeding seasons for which there is nesting data. It should be noted that since implementation of ERTP water management operations, that in 2013 and again in 2014, WCA-3A accounted for 13% and 12%, respectively, of range-wide nesting effort. It is important to note that although these increases are promising, they fall short of the effort observed prior to 1999.

The Kissimmee Chain of Lakes (KCOL), in particular, Lake Tohopekaliga, consistently supports high numbers of snail kites in Florida. In recent years, the shift in dependence from Lake Okeechobee and WCA-3A to the KCOL is readily 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). The high dependence on one area is of concern due to stochastic events, droughts, water management regimes within the KCOL and the presence of the exotic apple snail (*Pomacea insularum*). Juvenile snail kites are not efficient at handling the exotic snail, which is larger in size than the native, and thus, their survival may be suppressed (Cattau 2008). In recent years, snail kite nesting has decreased within KCOL, accounting for only 14% of young fledged (Fletcher et al. 2015). Fletcher et al. (2015) hypothesize that the downward trend in relative contribution made by KCOL is largely derived from expansion of nesting distribution and an increase in nest abundance in more southerly parts of the range but also note that the actual number of nests observed within KCOL in 2014 was sharply lower than the numbers observed in 2013, 2012 and 2011.

Recent population viability analyses predict a high probability of extinction in the next 50 years, or sooner, if current reproduction, survival and drought frequency rates remain the same as those of the last ten years (Martin et al. 2007; Cattau et al. 2008, 2009). It is imperative to manage WCA-3A and Lake Okeechobee so that they once again become functioning components of the snail kite's network of wetlands within Florida to ensure survival of the snail kite within Florida.

Recent research has identified that during the breeding season, the snail kite population is comprised of two distinct adult subpopulations with fewer movements occurring between subpopulation as compared with movement within subpopulations (Fletcher et al. 2013, Reichert 2014). Based upon data collected between 1996 and 2014 on nesting events of 1-year old birds, Fletcher et al (2015) noted that 39.2% exhibited natal philopatry. When the researchers included first observed nests for 1-year old and 2-year old birds, 43.8% exhibited natal philopatry. For birds that did disperse beyond their natal wetland, 86.7% of 1-year old dispersers and 81% of 1-year and 2-year old birds nested in a wetland of the same natal wetland type; thus when combining natal philopatry with natal dispersal, 91% of 1-year old birds and 89% of 1-year and 2-year old birds nested in natal wetland type (Fletcher et al. 2015). When looking across snail kite range, there is little movement of birds between KCOL and the Everglades and vice versa. In addition, there has been more observed dispersal of breeding snail kites between KCOL and Lake Okeechobee than between Lake Okeechobee and the Everglades (Fletcher et al. 2015). This evidence further underscores limitation of ERTP action area for snail kite to WCA-3A and ENP.

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). WCA-3A has been previously 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 principal concern is the lack of reproduction within this area since 1998. The WCA-3A Regulation Schedule, associated with IOP operations shortened the window of time during which kites could breed, and rapid recession rates often resulted in nest abandonment (Cattau et al. 2008). USACE has funded a program to monitor nesting effort and success of the snail kite in WCA-3 since 1995 with Wiley Kitchens, Ph.D., of USGS and the University of Florida as principal researcher. The study objectives are to track the numbers and success of snail kite nesting activities in WCA-3A as part of an on-going demographic study of snail kite over its range and to identify the environmental variables related to successful breeding. USACE also funded Dr. Kitchens to monitor vegetation responses to altered hydrologic regimes in WCA-3A in areas of traditional snail kite nesting and foraging habitat, in accordance with recommendations in the 2006 IOP BO.

The snail kite population in Florida has progressively and dramatically decreased since 1999 (Martin et al. 2006b,c; Cattau et al. 2008, 2009). The population essentially halved between 2000 and 2002 from approximately 3,400 to 1,700 birds; and halved again between 2006 and 2008 from approximately 1,500-1,600 birds in 2006 to approximately 685 birds in 2008. The estimated 2009 population size of 662 birds indicates that there is no sign of recovery (Cattau et al. 2009). Each decline has coincided, in part, with a severe regional drought throughout the southern portion of the snail kite's range (Martin et al. 2008; Cattau et al. 2008). Survival of both juveniles and adults rebounded shortly after the 2001 drought, but the number of young produced has not recovered from a sharp decrease that preceded the 2001 drought. Historically, the WCAs, and WCA-3A in particular, have fledged, proportionally, the large majority of young in the region. However, no young were fledged out of WCA-3A in 2001, 2005, 2007, or 2008, and only two young successfully fledged in 2009. Nesting activity is summarized in **Table 6** for the years 1998-2014, since the Emergency Deviations to WCA-3A Regulation Schedule for the protection of CSSS began in 1998. This trend of lowered regional reproduction is a cause of concern regarding the sustainability of the population. A population viability analysis conducted in 2006 predicted very high extinction probabilities within the next 50 years (Martin 2007). More recent evidence suggests that the population has increased since 2009 with an estimated population size of 1218 birds in 2012, 1198 birds in 2013 and 1754 birds in 2014 (Fletcher et al. 2015). In addition, Fletcher et al. (2015) report that since 2010, the 3-year running average population growth rate has been significantly greater than 1.0, indicating that the population has entered into a recovery phase.

TABLE 6. SUCCESSFUL SNAIL KITE NESTS AND THE NUMBER OF YOUNG SUCCESSFULLY FLEDGED WITHIN WCA-3 SINCE IMPLEMENTATION OF WATER MANAGEMENT ACTIVITIES FOR THE PROTECTION OF THE CAPE SABLE SEASIDE SPARROW*

Year	Number of Successful Nests	Number of Young Successfully Fledged
1998	84	176
1999	14	19
2000	33	56
2001	0	0
2002	22	32
2003	28	32
2004	19	29
2005	0	0
2006	13	13
2007	0	0
2008	0	0
2009	1	2
2010	0	0
2011	11	11
2012	1	1
2013	17	27
2014	21	36

* *i.e.* Emergency Deviations 1998, 1999; ISOP 2000, 2001;IOP 2002-2012; ERTP 2013, 2014

Both short-term natural disturbances (*e.g.* drought) and long-term habitat degradation limit the snail kite's reproductive ability. To date, most concern and interest regarding potential impacts to snail kites have focused on the higher water levels and hydroperiods occurring during IOP, resulting in the conversion of wet prairies to sloughs within WCA-3A (Zweig 2008). The IOP WCA-3A Regulation Schedule did not mimic the seasonal patterns driven by the natural hydrological cycle, resulting in water depths in WCA-3A that are too high for the period of September through January (Cattau et al. 2008). In addition, Dr. Kitchens and his research team felt that management activities associated with attempting to mitigate potential high water level impacts may well have potentially amplified those detrimental impacts to snail kite nesting and foraging activities. For example, in addition to the negative effect on reproduction, the rapid water level recession rates from the elevated stage schedule between February and July, intended to mitigate the extended hydroperiods and excessive depths between September and December, present extreme foraging difficulties to both juvenile and adult snail kites. In fact, Cattau et al. (2008) demonstrated that the recession rate had significant effects on nest success. Recession rate was defined as the stage difference between that on January 1 and the annual minimum stage divided by the number of days from January 1 to the annual minimum stage (Cattau et al. 2008).

As a result of the on-going research, Dr. Kitchens and his research team identified three major potentially adverse effects associated with IOP WCA-3A Regulation Schedule as: 1) prolonged high water levels in WCA-3A during September through January; 2) prolonged low water levels in WCA-3A during the early spring and summer; and 3) rapid recession rates. Each is discussed in detail below.

PROLONGED HIGH WATER LEVELS

From approximately 1993 to present, which coincides with Test 7 of the MWD Experimental Program and subsequent ISOP and IOP operations, WCA-3A stages have shown relatively little annual variation compared to the previous decades, with an annual average stage of approximately 9.5 feet (2.9 meters). In addition, stages in WCA-3A exceeded 10.5 feet (3.2 meters) in 12 of the 17 years between 1993 and 2009, while there were only approximately four occurrences of stages exceeding 10.5 feet (3.2 meters) during the 40-year period from 1953 to 1993. Stages in 1994, 1995, 1999 and 2008 also exceeded 11.5 feet (3.5 meters), and are the four highest stages within the period of record (FWS 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 habitat in WCA-3A (IOP FSEIS 2006). However, in their 2002 and 2006 IOP BOs, FWS determined that IOP would adversely affect snail kites and designated snail kite critical habitat in WCA-3A, but would not likely jeopardize the species. As stated in the 2006 Final IOP BO, FWS anticipated that IOP would result in incidental take in the form of "harm" resulting from reduced ability to forage successfully due to habitat changes that affect prey availability.

High water levels during the wet season are important in maintaining quality wet prairie and emergent slough habitat (FWS 2010). However, high water levels and extended hydroperiods have resulted in vegetation shifts within WCA-3A, degrading snail kite critical habitat. The extended flooding from September to January resulting either from weather conditions, IOP, or both, appears to be shifting plant communities from wet prairies to open water sloughs (Zweig 2008; Zweig and Kitchens 2008). These 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).

This vegetation transition directly affects snail kites in several ways, most importantly by reducing the amount of suitable foraging and nesting habitat, and reducing prey abundance and availability. Wetter conditions reduce the amount of woody vegetation within the area upon which snail kites rely for nesting and perch hunting. In addition, 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). Drying events are essential in maintaining the mosaic of vegetation types needed by a variety of wetland fauna (Sklar et al. 2002), including the snail kite (FWS 2010) and its primary food source, the apple snail (Karunaratne et al. 2006; Darby et al. 2008). However, little annual variation in water depths has occurred within WCA-3A since 1993, virtually eliminating the drying events necessary to maintain this mosaic. This is particularly apparent in southwestern WCA-3A, which has experienced excessive ponding in recent years.

Prey availability has also been affected by the vegetation transition. Apple snails tend to avoid areas where water depths are greater than 50 centimeters (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 apple 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 densities. Research indicates that apple 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.), along with sawgrass that grows within the ecotones between the two vegetative communities, 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. Drying events are needed to maintain the emergent plant species characteristic of typical apple snail and snail kite habitat (Wood and Tanner 1990; Davis et al. 1997). As shown by Darby et al. (2008), apple snails can survive these events and it is the timing and duration of the dry down event that are critical determinants of apple snail survival and recruitment.

PROLONGED LOW WATER LEVELS

Under the IOP WCA-3A Regulation Schedule, there was a high likelihood that the water levels in WCA-3A will fall below a critical threshold (below which snail kite foraging success and apple snail reproduction is severely reduced) for an extended period of time. Zone E1 was first incorporated into the WCA-3A deviation schedule under ISOP and subsequently included in IOP. The 0.5 feet (15 centimeters) reduction in the bottom zone (Zone E) of the WCA-3A

Regulation Schedule was intended to help offset the effects of reduced outflows through the S-12 structures that resulted from IOP closures for protection of CSSS in the dry season and early wet season. This change resulted in a greater reduction in WCA-3A stages prior to the wet season. While this zone may have helped to achieve the desired result of reducing high water impacts that could result from S-12 closures during the early wet season, it may have contributed to detrimental impacts to snail kite nesting and foraging within WCA-3A. During the years of ISOP and IOP operations, the low stages (as indicated by gauge 3A-28) that occurred have reached approximately 8.4 feet (2.6 meters), with the exception of 2003, when the low reached 8.9 feet (2.7 meters). In the six years prior to IOP, the low stages at Gauge 3A-28 (Site 65) had been above approximately 8.9 feet (2.7 meters) at their lowest point. A difference of 0.5 feet (15 centimeters) is not large. However, depending on where snail kites choose to nest, this difference could have a notable impact on how hydrologic conditions change near snail kite nests during the spring recession. Snail kites' reliance on the area immediately around the nest for foraging and capturing sufficient prey to feed nestlings during the two months of the nestling period make them vulnerable to rapidly changing hydrologic conditions.

Low water levels have a significant effect on snail kite nest success in WCA-3A (Cattau et al. 2008). If water levels become too low and food resources become too scarce, adults will abandon their nest sites and young (Sykes et al. 1995). A strong relationship exists between juvenile snail kite survival rate and annual minimum stage (Martin et al. 2007; Cattau et al. 2008). Estimated juvenile snail kite survival rates for years when water levels fell below 10 centimeters was substantially lower compared to years where estimated water depths stayed above 10 centimeters (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 low apple snail availability), juvenile survival will be diminished.

Apple snail egg production is maximized when dry season low water levels are less than 40 centimeters but greater than 10 centimeters (Darby et al. 2002; FWS 2010). Water depths outside this range can significantly affect apple snail recruitment and survival. If water levels are less than 10 centimeters, apple snails cease movement and may become stranded, hence they are not only unavailable to foraging snail kites, they are also unable to successfully reproduce. Depending upon the timing and duration of the dry down, 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% of all apple snail egg cluster production occurs between April and June (Darby et al. 2008). Dry downs during peak apple snail egg cluster production substantially reduce recruitment (Darby et al. 2008). If possible, dry downs during this critical time frame should be avoided. The length of the dry down, age and size of the apple snail are all important factors in apple snail recruitment and survival. Larger apple snails can survive dry downs better than smaller apple snails (Kushlan 1975; Darby et al. 2006, 2008). In fact, Darby et al. (2008) found that 70% of pre-reproductive adult-sized apple snails survived a 12-week dry down; while smaller apple snails exhibited significantly lower survival rates (less than 50% after 8 weeks dry).

There is a delicate trade-off between low and high water, and timing seems to be critical. Drying events following managed recessions have the potential to induce mortality of juvenile and adult snail kites and apple snails, whereas repeated and extended flooding tends to result in long-term degradation of the habitat, which also reduces reproduction and hinders kite recovery.

RAPID RECESSION RATES

Given the high water levels early in the nesting season, birds are initiating nests in upslope shallower sites. Often water managers initiate rapid recession rates to meet the target regulation schedule and avoid impacts of sustained higher water levels. These rapid recession rates have serious implications for snail kite nesting success. Breeding adults may not be able to raise their young before the water levels reach a critical low, below which apple snail availability to snail 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 is further reduced in these areas. Of all the hydrological variables modeled by Cattau et al. (2008), recession rate had the strongest negative effect on nest success.

Rapid recession rates also result in reduced apple snail productivity. Apple snails may become stranded if water levels fall too rapidly, effectively preventing apple snails from reaching areas of deeper water. Stranded apple snails cease movement and as a result, apple snail reproduction is essentially terminated.

In order to address these adverse effects, FWS along with Dr. Kitchens, Phil Darby, Ph.D. of the University of West Florida, and Christa Zweig, Ph.D. of the University of Florida, developed a series of water depth recommendations for WCA-3A that addresses the needs of the snail kite, apple snail and vegetation characteristic of their habitat (**Figure 26**). This water management strategy is divided into three time periods representing the height of the wet season (September 15 to October 15), the pre-breeding season (January) and the breeding season (termed dry season low, May 1 to June 1) and illustrates appropriate water depths to attain within each time period. Water depth recommendations as measured at the WCA-3AVG proposed within the FWS water management transition strategy form the basis for ERTP. These recommendations and their proposed intent are summarized are included in their entirety in **Appendix A**. Please note that these water depths are not targets and represent a compromise between the needs of the three species. As noted in **Appendix A** under the intent section, interannual variability is extremely important in the management of the system to promote recovery of the species. The recommendations within the FWS Multi-Species Transition Strategy (MSTS) form the basis for ERTP PMs and ETs. The inclusion of these recommendations into ERTP represents a significant improvement over IOP operations. **Appendix A** includes a graphical comparison of IOP and ERTP operations with respect to the ERTP PMs for the snail kite and apple snail including WCA-3A water depths, recession and ascension rates.

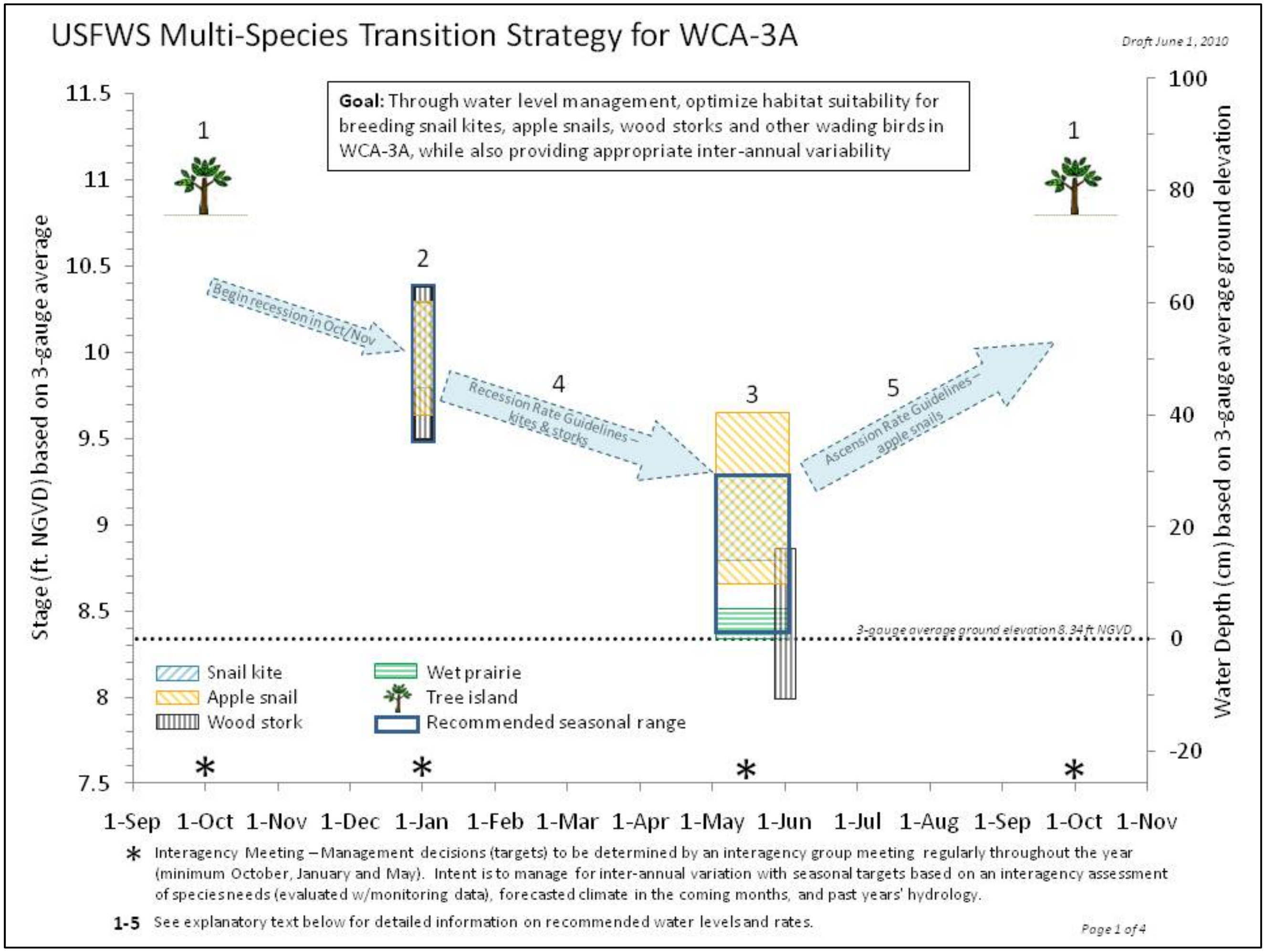


FIGURE 26. U.S. FISH AND WILDLIFE SERVICE MULTI-SPECIES TRANSITION STRATEGY FOR WCA-3A

Note: Please refer to **Appendix A** for a full description of this strategy.

5.5.9.1 POTENTIAL EFFECTS TO SNAIL KITE

USACE recognizes that until completion of CEPP and CERP, there are few opportunities within the current constraints of C&SF system to completely avoid impacts to listed species. Although the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the previous operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered snail kite.

Major components of ERTP that may affect the snail kite and its designated critical habitat include modifications of the WCA-3A Regulation Schedule and removal of the S-12C IOP closure dates. Other ERTP action components that will have little impact on the snail kite include Rainfall Plan Target Flows, S-346 and S-332D operations, Pre-storm, Storm, and Storm Recovery Operations for the SDCS. In addition, WCA-3A PSC will 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. These ERTP components were fully evaluated in the October 2010 ERTP Biological Assessment and are hereby incorporated as reference (**Appendix A**). This section of this Supplemental Biological Assessment will explore potential effects the four main reasonable and prudent measures under USACE authority identified during informal consultation that may act to further protect CSSS. These include 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.

5.5.9.1.1 MWD INCREMENT 1 FIELD TEST

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). Over this cumulative historical hydrologic analysis period, the MWD Increment 1 Field Test would be 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% 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 WCA-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 FWS on January 6, 2015, USACE 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. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.9.1.2 OPERATIONAL FLEXIBILITY WITHIN ERTP

The ERTP WCA-3 Interim Regulation Schedule is shown in **Figure 7**. The revisions from IOP WCA-3 Regulation Schedule included incorporation of the WCA-3A 1960 9.5 to 10.5 feet NGVD Zone A, along with expansion of Zone D forward to December 31 and expansion of Zone E1 backwards to January 1. 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. Table A-1, **Appendix A** provides a detailed description of the modification.

As previously discussed, water levels within portions of WCA-3A (*e.g.* southwestern 3A) have been too high for too long resulting in detrimental effects to vegetation, apple snails and snail kites. Under ERTP, the lowered WCA-3A Interim Regulation Schedule Zone A (*i.e.* 9.75 to 10.75 feet NGVD under IOP versus 9.50 to 10.50 feet NGVD under ERTP), provides an additional mechanism to reduce high water levels within WCA-3A, and have the potential to provide beneficial effects to the snail kite and its critical habitat within WCA-3A.

Two detrimental impacts associated with the creation of Zone E-1 observed under IOP included rapid recession rates and low water levels during the snail kite's breeding season. In order to correct these detrimental impacts under ERTP, both a recession rate and a low water level criterion were developed. ERTP includes a recession rate criterion of 0.05 feet per week between January 1 and June 1 (ERTP PM D) to avoid recession rates that are too rapid and thus detrimental to snail kites and apple snails. In addition, to avoid water levels that are too low at the end of the dry season, specific water depth criteria have been developed based on the stage at the WCA-3AVG. The criteria include depths favorable for snail kites, apple snails and wet prairie vegetation and were created in conjunction with the species experts (Dr. Kitchens, Dr. Darby, and Dr. Zweig) and FWS.

Since ERTP was implemented in October 2012, there have been two breeding seasons in which water management operations included the flexibility provided by the WCA-3A regulation schedule as well as the allowance of flows through the S-12C structure to assist to reduce water depths within WCA-3A. Please refer to **Appendix B** for the Water Year 2013 and Water Year 2014 ERTP Annual Assessments for a detailed evaluation of ERTP Incidental Take Triggers related to the endangered snail kite as well as a detailed evaluation of ERTP PMs and ETs that specifically address snail kite and its primary prey, Florida apple snail. A brief summary of ERTP water management operations in relation to these metrics is included below. It is important to note that since implementation of ERTP operations, there has been an increase in snail kite nesting within WCA-3A (**Table 6**). Whether this increase is related to water management operations under ERTP or invasion of WCA-3A by exotic apple snails (Darby et al. 2013, 2014), or a combination of both has yet to be determined.

Water Depth Recommendations

ERTP PM-B states that for snail kite, strive to reach water levels between 9.8 and 10.3 feet, NGVD by December 31 and between 8.8 and 9.3 feet, NGVD between May 1 and June 1 (as measured at WCA-3AVG). As shown in **Table 7**, water levels on December 31 during Water Year 2013 and Water Year 2014 were within the preferred depth range. However, minimum water depths between May 1 and June 1 were above the preferred range in Water Year 2013 and below the preferred range in Water Year 2014. Although PM-B was not met in either year, USACE attributed the water depth variations to rainfall experienced throughout WCA-3A. For example in 2013, approximately 8.97 inches of rainfall was reported for WCA-3AVG in May, 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. Similarly in 2014, USACE attributed the lower than preferred water depths during May 1 to June 1 in 2014 to a combination of lack of rainfall and evapotranspiration experienced throughout the region (9.41 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. USACE will continue to use PSC recommendations to target water depths and recession rates within WCA-3A to better meet the requirements of listed species. PM-C which ascribed similar water depth recommended range for the benefit of the apple snail showed a similar trend as that described for PM-B during Water Year 2013 and Water Year 2014 (**Table 7**; refer to **Appendix B** for full details).

TABLE 7. WCA-3AVG WATER LEVELS (FEET, NGVD) ON DECEMBER 31 AND THE MAXIMUM AND MINIMUM WATER LEVELS BETWEEN MAY 1 AND JUNE 1

Year^	Total Annual Precipitation (inches; WCA-3A Radar)	WCA-3AVG Stage (feet, NGVD) December 31	PM-B met?	PM-C met?	Minimum WCA-3AVG Stage May 1 to June 1 (feet, NGVD)	Maximum WCA-3AVG Stage May 1 to June 1 (feet, NGVD)	PM-B met?	PM-C met?
2010	-	9.57	No	No	-	-	-	-
2011	42.33	-	-	-	7.66	8.12	No	No
2012	59.55	10.24	Yes	Yes	9.24	10.00	No	No
2013	51.56	10.29	Yes	Yes	9.37	9.57	No	Yes
2014	30.80*	10.03	Yes	Yes	8.60	8.98	Yes	No

^ERTP operations were implemented in October 2012
*Note: Precipitation data was available only for the period between October 1, 2013 and July 31, 2014

Recession Rate Recommendations

PM-D states that within WCA-3A for snail kite strive to maintain a recession rate of 0.05 feet per week from January 1 to June 1 (or onset of the wet season). This equates to a stage difference of approximately 1.0 feet between January and the dry season low. For the two breeding seasons in which water management operations were under ERTP, the observed recession rates are illustrated in **Table 8** and **Table 9**. As shown in Table 8, during Water Year 2013 (October 2012 through September 30, 2013), recession rates were greater than preferred for the week ending March 31, all other recession rates were within the green or yellow FWS 2010 ranges. Recession rates reversals occurred during the weeks ending April 7, April 21, May 5 and June 2, 2013 and were attributed to rainfall events within WCA-3A (**Table 7**). The dry season stage difference did not exceed the preferred range (**Table 10**). Similarly, as shown in **Table 8**, during Water Year 2014 (October 2013 through September 30, 2014), recession rates were greater than preferred for the week ending April 28, May 12 and May 26; all other recession rates were within the green or yellow FWS 2010 ranges. Recession rate reversals occurred during the weeks ending February 4, May 19, and June 2, 2014 and were attributed to rainfall events within WCA-3A. The dry season stage difference exceeded the preferred range during Water Year 2014 (**Table 10**).

TABLE 8. OBSERVED WEEKLY RECESSION RATE FROM JANUARY 1 THROUGH JUNE, 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
4-Feb	0.09	21-Apr	-0.04
11-Feb	0.07	28-Apr	0.02
18-Feb	0.02	5-May	-0.28
25-Feb	0.06	12-May	0.04
3-Mar	0.05	19-May	0.06
10-Mar	0.08	26-May	0.05
17-Mar	0.10	2-Jun	-0.24

* Note: Numbers are highlighted to correspond to FWS Multi-Species Transition Strategy (MSTS) stoplight key below (FWS 2010).

TABLE 9. OBSERVED WEEKLY RECESSION RATE FROM JANUARY 1 THROUGH JUNE, 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	0.09
21-Jan	0.07	7-Apr	0.09
28-Jan	0.07	14-Apr	0.09
4-Feb	-0.09	21-Apr	0.03
11-Feb	0.05	28-Apr	0.13
18-Feb	0.03	5-May	0.07
25-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

* Note: Numbers are highlighted to correspond to FWS Multi-Species Transition Strategy (MSTS) stoplight key below (FWS 2010).

FWS 2010 Key:

FWS MSTS Recession Rate (feet per week)
> .10
> 0.05 but ≤ 0.10
0.05
≥ 0.00 but < 0.05
< 0.00

TABLE 10. OBSERVED WCA-3A STAGE DIFFERENCE FROM JANUARY 1 THROUGH JUNE 1 BASED UPON THE WCA-3AVG. VALUES GREATER THAN 1.0 REPRESENT STAGES DIFFERENCES THAT WERE GREATER THAN RECOMMENDED BETWEEN JANUARY AND JUNE 1.

Year	WCA-3A Stage Difference January 1 to June 1 (WCA-3AVG)
2011	1.90
2012	0.39
2013	0.74
2014	1.34

Ascension Rate Recommendations

PM-E states that in order to avoid drowning of apple snail egg clusters, manage for a monthly rate of rise ≤0 .25 feet per week. As shown in **Table 11** in general, PM-E was attained throughout the majority of the months between February and September in Water Year 2013 and Water Year 2014. Although recession rates were favorable for apple snail reproduction Therrien et al. (2014) reported that native apple snail densities and egg production were gee rally low throughout most of WCA-3A with the exception of southwestern WCA-3A where snail kites were noted to be actively foraging and nesting (Fletcher et al. 2015). In addition, the 2014 egg cluster survey indicate the presence of snails in the larger expanse of WCA-3A but the combined cluster count and throw trap data indicate that although present, native snails exist at low densities insufficient (<0.15 snails/m^2) to support foraging kites even though suitable habitat is available (in terms of plant community structure) (Therrien et al. 2014).

TABLE 11. WEEKLY RATE OF RISE (FEET/WEEK) BASED ON THE WCA-3AVG FOR THE MONTHS OF FEBRUARY THROUGH SEPTEMBER (POSITIVE VALUES INDICATE FALLING WATER, NEGATIVE VALUES INDICATE RISING WATER)

Year	Average Weekly Rate of Rise (feet/week) based upon WCA-3AVG stage							
	February	March	April	May	June	July	August	September
2011	0.08	0.06	0.16	0.10	-0.23	-0.08	-0.15	-0.09
2012	0.04	0.12	0.02	-0.15	-0.10	0.01	-0.09	-0.18
2013	0.06	0.09	-0.03	-0.03	-0.19	-0.29	0.08	0.00
2014	0.03	0.09	0.09	0.08	-0.10	-0.04	-0.18	-0.13

Another negative impact on snail kite nest success under IOP operations was rapid recession rates (Cattau et al. 2008). As indicated by Cattau et al. (2008), however, the effects of recession rates may be buffered by other hydrological variables (e.g. annual minimum stage, depth). To improve the likelihood of successful snail kite nesting in WCA-3A, ERTP incorporates FWS MSTS recession rate recommendation of 0.05 feet/week from January 1 until June 1 (or the onset of the wet season) as PM-D. Recession rates less than 0.05 feet/week or more than 0.05 feet but less than 0.10 foot/week are considered acceptable under certain environmental conditions. However, since rapid recession rates were identified as adversely affecting snail kite nesting in WCA-3A, recession rates that are slower than 0.05 feet/week would not have as great of a negative impact as would recession rates more than 0.05 feet but less than 0.10 feet/week. Under ERTP, the recession rate for any given week or period of time will be determined based upon recommendations made during the WCA-3A PSC. In order to meet the WCA-3A PSC recommended recession rates for any given period, USACE will 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 USACE may make less than the maximum release in order to achieve WCA-3A PSC recommendation. In addition, ERTP allows 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 conducive to snail kites and apple snails. These strategies epitomize ERTP paradigm shift in which operational flexibility and adaptive management will be employed to meet the needs of multiple species that depend upon WCA-3A. Adjustments to prioritization of pumping at the S-332 structures are not anticipated to affect snail kite.

5.5.9.1.3 WATER FLOW ANALYSIS TEST

The proposed Water Flow Analysis Test will 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. If the results of the Water Flow Analysis Test indicate that flows from sources other than the S-12A, S-12B, S-343A, S-343B or S-344 structures have a negative effect on CSSS-A, there may be future opportunities to limit restriction dates on these structures; thereby benefitting snail kite by having additional outlet capacity to reduce high water conditions within WCA-3A. Any reasonable and prudent measures that result from information gained through the Water Flow Analysis Test will be addressed through separate ESA consultation with FWS and any effects on Everglade snail kite will be described within a future Biological Assessment.

5.5.9.1.4 L-28 BORROW CANAL

The USACE will prepare an assessment, using an interagency team, 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, USACE 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 multiagency team to include FWS, 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. This effort will require authorization, NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of L-28 Borrow Canal options within this Supplemental Biological Assessment. Since at this point this reasonable and prudent measure is solely an assessment, USACE has concluded that any L-28 Borrow Canal Planning Study will have no effect on snail kite.

5.5.9.2 SNAIL KITE SPECIES EFFECT DETERMINATION

Snail kites forage and nest within ERTP action area. ERTP modifications to IOP regulations 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. In addition, ERTP incorporates FWS MSTS and thus includes specific water depths and recession rates designed to improve nesting and foraging conditions for snail kite. Included within this strategy are provisions for snail kite's primary food source, the apple snail, along with the vegetation characteristic of their habitat. Hydrological changes associated with continued implementation of ERTP are expected to alter and slightly improve some of the physical and biological features essential to the nesting and foraging success of the species. These changes pose fewer impacts on the snail kite, apple snail and their habitat as compared with IOP operational regime and thus represent an improvement to water management operations. Also included with continued implementation of ERTP is the WCA-3A PSC which along with the expansion of zones D and E1 within the WCA-3A Interim Regulation Schedule and preemptive releases will allow for more flexibility in adaptively managing WCA-3A for the benefit of a multitude of species including the endangered snail kite. As such, USACE has determined the action may affect snail kite and thus is requesting formal consultation under ESA. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring could minimize potential adverse effects to the species.

5.5.9.3 SNAIL KITE CRITICAL HABITAT DETERMINATION

Critical habitat for the snail kite was designated on September 22, 1977 (42 FR 47840 47845) and includes areas of land, water and airspace within portions of the St. Johns Reservoir, Indian River County; Cloud Lake Reservoir, St. Lucie, County; Strazzulla Reservoir, St. Lucie County; western portions of Lake Okeechobee, Glades and Hendry counties; Loxahatchee National Wildlife Refuge (WCA-1), Palm Beach County; WCA-2A, Palm Beach and Broward counties; WCA-2B, Broward County; WCA-3A, Broward and Miami-Dade counties; and ENP to the Miami-Dade/Monroe County line. Because this was one of the first critical habitat designations under the ESA, there were no primary constituent elements defined. The designated area encompasses approximately 841,635 acres (340,598 hectares; **Figure 13**).

Since the designation in 1977, FWS has consulted on the loss of 18.66 acres (7.55 hectares) of critical habitat in a construction project. Construction of C&SF infrastructure resulted in impacts to less than 20 acres (8.1 hectares) of critical habitat. A FWS BO addressed the effects of construction of the Miccosukee Tribe's Government Complex Center on critical habitat, which resulted in the loss of 16.88 acres (6.83 hectares) of critical habitat. In addition, the FWS has consulted on impacts to 88,000 acres (35,612 hectares) of critical habitat resulting from prolonged flooding and temporary degradation of critical habitat because of prescribed fire. In addition to these projects, degradation of snail kite habitat has occurred because of the effects of long-term hydrologic management and eutrophication. While it is not possible to accurately estimate the changes that have occurred within each unit, approximately 40% of the original designation is estimated to be in degraded condition for snail kite nesting and foraging relative to when it was designated in 1977.

Although previously located in freshwater marshes over considerable areas of peninsular Florida, the range of the snail kite is currently more limited. This bird is now restricted to several impoundments on the headwaters of the St. John's River; the southwest side of Lake Okeechobee; the eastern and southern portions of WCA-1, WCA-2A and WCA-3; the southern portion of WCA-2B; the western edge of WCA-3B; and the northern portion of ENP (FWS 1996).

Based upon annual surveys from 1970 to 1994, 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 (Bennetts and Kitchens 1997). 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 (Zweig and Kitchens 2008).

Sustained high water levels have resulted in the conversion of wet prairies (preferred foraging habitat for snail kites) to aquatic sloughs in selected sites within WCA-3A; along with losses of interspersed herbaceous and woody species essential for nesting and perch hunting. Vegetation monitoring addresses the concern that IOP could adversely affect the structure and function of vegetation communities in WCA-3A, portions of which are designated critical habitat for the snail kite. The principal concern is that the habitat quality, and thus the carrying capacity, of WCA-3A is already seriously degraded. Studies by Zweig (2008) and Zweig and Kitchens (2008) tend to confirm these concerns. Since 1998 and the start of water management regimes for the protection of CSSS, snail kite production in WCA-3A has dramatically dropped, having produced no snail kites in 2005, 2007, 2008 and only two birds in 2009 (Martin 2007, Martin et al. 2007; Cattau et al. 2009). This coincides with successive annual shifts (2002, 2003, 2004, and 2005) in community types within the slough/prairies at sites reported in 2002 to be prime areas of apple snail abundance, and thus snail kite foraging, in WCA-3A. The conversion trend from emergent prairies/sloughs to deep water sloughs is certainly degradation in habitat quality for the snail kites. Habitat quality in WCA-3A is changing progressively and dramatically to less desirable habitat in this critical area, and this conversion is rapid, with changes evident in just one year (Zweig and Kitchens 2008). Continuation of the monitoring protocol would allow these changes to be tracked for indications of rebound or continued degradation, as well as separate the effects of hurricanes from those that might be due to continued implementation of ERTP.

5.5.9.4 SNAIL KITE CRITICAL HABITAT DETERMINATION

In the 2006 IOP BO, FWS recognized that degradation of critical habitat within WCA-3A would continue, but determined that it is not likely to result in jeopardy to the snail kite. Furthermore, FWS concluded that this habitat degradation would be reversible under improved hydrologic conditions. No permanent loss of critical habitat was expected (FWS 2006). Modifications to IOP under ERTP were designed to reduce the frequency of damaging water levels (highs and lows). By restoring favorable hydrological conditions within WCA-3A, the observed habitat changes could potentially be reversed. However, the timeframe for this vegetation change is uncertain and fire may be a necessary catalyst. In addition, USACE recognizes that the proposed modifications, while helpful, do not represent full hydrological restoration within WCA-3A. However, given the current constraints of C&SF system, ERTP water management operations represent an improvement to the single species management embodied within IOP. Based upon this information, USACE determined that continued implementation of ERTP may affect snail kite critical habitat.

5.5.10 WOOD STORK AND “MAY EFFECT” DETERMINATION

The wood stork is a large, white, long-legged wading bird that relies upon shallow, freshwater wetlands for foraging. Black primary and secondary feathers, a black tail and a blackish, featherless neck distinguish the wood stork from other wading birds species. This species was federally listed as endangered under the ESA on February 28, 1984. On June 30, 2014, FWS reclassified the status of wood stork from endangered to threatened due to improvement in the species overall status. Although habitat loss and fragmentation continue to impact the species, FWS cited that due to increases in abundance of the breeding population as well as a significant expansion of its breeding range, there is a decrease in the severity and magnitude of these threats. Therefore, this species is no longer in danger of extinction throughout their range and has been reclassified as threatened. No critical habitat has been designated for the wood stork; therefore, none will be affected.

The wood stork is found from northern Argentina, eastern Peru and western Ecuador north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (AOU 1983). Only the population segment that breeds in the southeastern United States is listed as threatened. In the United States, this species is 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). Dahl (1990) estimates these states lost about 38 million acres, or 45.6 percent, of their historic wetlands 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 flats. These wetlands were strongly preferred by wood storks as nesting habitat. Currently, wood stork nesting is known to occur in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks are currently documented in all southern Florida counties except for Okeechobee County.

The wood stork population in the southeastern United States appears to be increasing. Preliminary population totals indicate that the wood stork population has reached its highest level since it was listed as endangered in 1984. In all, approximately 11,200 wood stork pairs nested within their breeding range in the southeastern United States. Wood stork nesting was first documented in North Carolina in 2005 and wood storks have continued to nest in this state through 2009. This suggests that the northward expansion of wood stork nesting may be continuing.

The decline in the United States population of the wood stork is thought to be related to one or more of the following factors: 1) reduction in the number of available nesting sites; 2) lack of protection at nesting sites; and 3) loss of an adequate food base during the nesting season (Ogden and Nesbitt 1979). Ogden and Nesbitt (1979) indicate a reduction in nesting sites is not the cause in the population decline, because the number of nesting sites used from year to year is relatively stable. Ogden and Nesbitt suggest loss of an adequate food base is a cause of wood stork declines.

The primary cause of the wood stork population decline in the United States is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. Almost any shallow wetland depression where fish become concentrated, either through 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 wood storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and the total acreage of wetland types occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973. They combined their data for habitat types known to be important foraging habitat for wood storks (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and saw grass marshes) and found these habitat types have been reduced by 35 percent since 1900.

Wood storks forage primarily within freshwater marsh and wet prairie vegetation types, but can be found in a wide variety of wetland types, as long as prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987; Gawlik and Crozier 2004; Herring and Gawlik 2007). Calm water, about 5 to 25 centimeters in depth, and free of dense aquatic vegetation is ideal, however, wood storks have been observed foraging in ponds up to 40 centimeters in depth (Coulter and Bryan 1993; Gawlik 2002). 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, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993; Herring and Gawlik 2007). During nesting, these areas must also be sufficiently close to the colony to allow wood storks to efficiently deliver prey to nestlings.

Wood storks feed almost entirely on fish between 2 and 25 centimeters (1 to 10 inches) in length (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). Wood storks typically wade through the water with their beaks immersed and open about 7 to 8 centimeters (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.

Studies on fish consumed by wood storks have shown that wood storks are highly selective in their feeding habits with sunfish and four other species of fish comprising the majority of their diet (Ogden et al. 1976). Ogden et al. (1976, 1978) noted that the key species consumed by wood storks included sunfishes (Centrarchidae), yellow bullhead (*Italurus natalis*), marsh killifish (*Fundulus confluentus*), flagfish (*Jordenella floridae*) and sailfin molly (*Poecilia latipinna*).

These species were also observed to be consumed in much greater proportions than they occur at feeding sites, and abundant smaller species (e.g., mosquitofish (*Gambusia* spp.), least killifish (*Heterandria formosa*), bluefin killifish (*Lucania goodei*) are under-represented, which the researchers believed was probably because their small size does not elicit a bill-snapping reflex in these tactile feeders (Coulter et al. 1999). Their studies also showed that in addition to selecting larger species of fish, wood storks consumed individuals that are significantly larger (greater than 3.5 centimeters) than the mean size available (2.5 centimeters), and many were greater than one-year old (Ogden et al. 1976; Coulter et al. 1999).

Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida. Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over three feet during the wet season (June-November), and then receding gradually during the dry season (December-May). 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 storks to access the wetlands (Gawlik 2002; Gawlik et al. 2004). 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).

In addition to the concentration of fish due to normal drying, several other factors affect fish abundance in potential foraging habitats. Longer hydroperiod areas generally support more fish and larger fish (Trexler et al. 2002; Jordan et al. 1998; Loftus and Ecklund 1994; Turner et al. 1999). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential wood stork foraging sites (Rehage and Trexler 2006), and 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 gradients, 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 wide variety of hydroperiod classes, nutrient conditions, and spatial variability.

Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high, the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987). Wood stork prey availability is dependent on a composite variable consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too great (greater than 30 centimeters) for storks or the tree canopy at the site is too dense for wood storks to land.

Dense submerged 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). Some submerged and emergent vegetation does not detrimentally affect wood stork foraging, and may be important to maintaining fish populations. Wood storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993; O’Hare and Dalrymple 1997; Coulter et al. 1999). Foraging sites with open canopies are more easily detected from overhead as wood storks are searching for food.

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, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, but while prey was still sufficiently available that other wading bird species were still foraging 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).

Wood storks generally forage in wetlands between 0.5 kilometer and 74.5 kilometer away from the colony site (Bryan and Coulter 1987; Herring and Gawlik 2007), but forage most frequently within 10-20 kilometer (12 miles) of the colony (Coulter and Bryan 1993; Herring and Gawlik 2007). 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 wood storks. Adults 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. Wood storks generally 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).

Wood stork nesting habitat consists of mangroves as low as 1 meter (3 feet), cypress as tall as 30.5 meters (100 feet), and various other live or 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 nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (Rodgers et al. 1996).
Figure 27 shows the locations of wood stork colonies throughout Florida between 2001 and 2014. The same colony site will be used for many years as long as the colony is undisturbed and sufficient foraging habitat remains in the surrounding wetlands. However, not all wood 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 that 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).

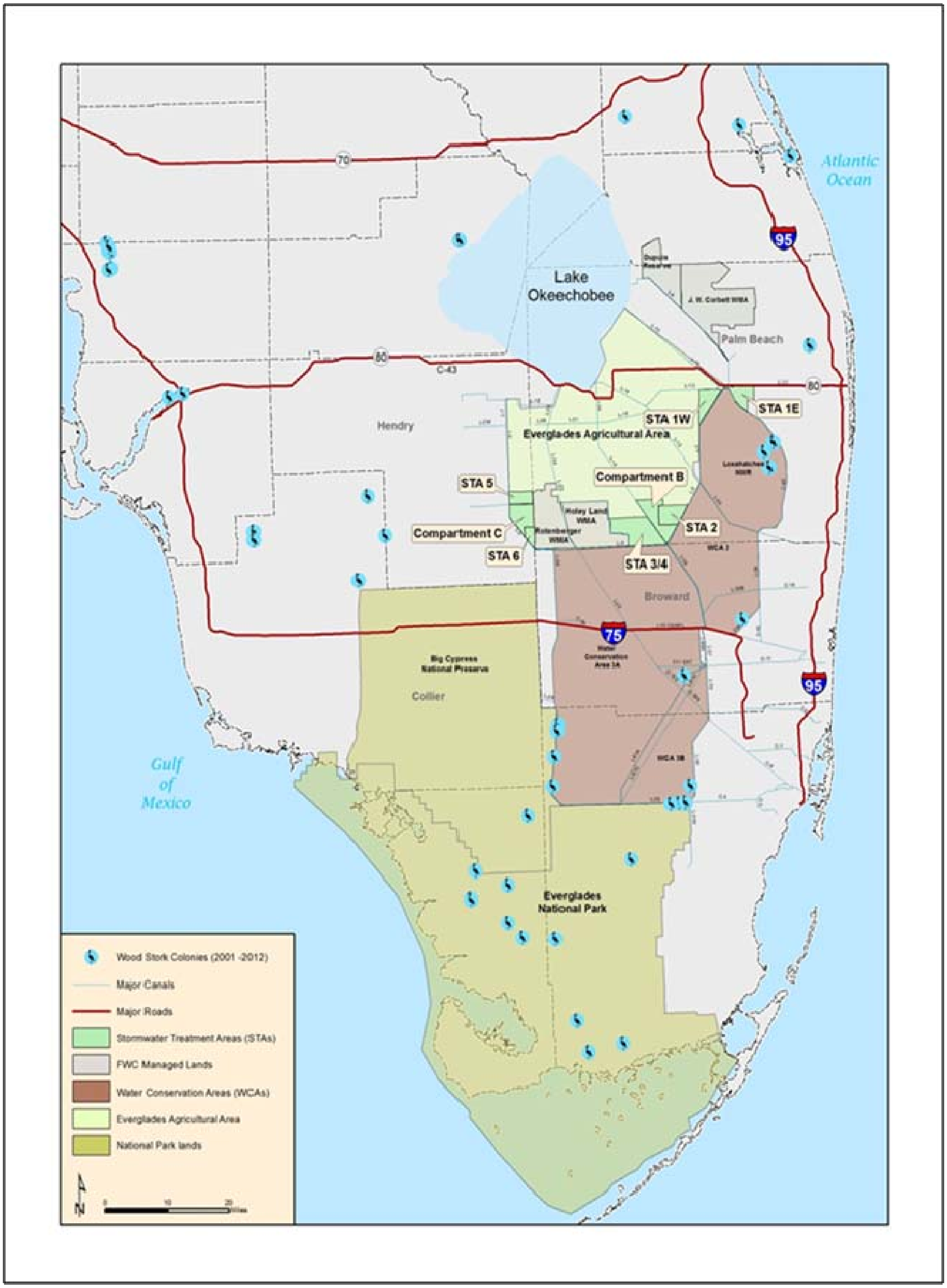


FIGURE 27: LOCATION OF WOOD STORK COLONIES IN FLORIDA BETWEEN 2001 AND 2014

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. Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony vary 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 (FWS 1997; Frederick and Ogden 2001). While the majority of wood stork nesting occurs within traditional wood stork rookeries, a handful of new wood stork nesting colonies are discovered each year (Meyer and Frederick 2004; SFWMD 2004, 2009). 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.

Breeding wood storks are believed to form new pair bonds every season. First age of breeding has been documented in 3- to 4-year-old birds but the average first age of breeding is unknown. Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990; FWS 1999). A single clutch of two to five (average three) eggs is 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 among years in the clutch sizes, and clutch size does not appear to be related to longitude, nest data, nesting density, or nesting numbers, and may be related to habitat conditions at the time of laying (Frederick 2009; Frederick et al. 2009; Frederick and Vitale 2014). Egg laying is staggered and incubation, which lasts approximately 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). In the event of diminished foraging conditions, the youngest birds generally do not survive.

The young fledge in approximately eight weeks but will stay at the nest for three to four more weeks to be fed. Adults feed the young by regurgitating whole fish into the bottom of the nest about three to ten times per day. Feedings are more frequent when the birds are young (Coulter et al. 1999). When wood storks are forced to fly great distances to locate food, feedings are less frequent (Bryan et al. 1995). The total nesting period from courtship and nest-building through independence of young, lasts approximately 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous, and consequently, a colony may contain active breeding wood storks for a period significantly 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 for a relatively short period following the completion of breeding. Appropriate water depths for successful foraging are particularly important for newly fledged juveniles (Borkhataria et al. 2008).

Wood storks produce an average of 1.29 fledglings per nest and 0.42 fledglings per egg which is a probability of survivorship from egg laying to fledgling of 42 percent (Rodgers and Schwikert 1997). However, in 2009, which was a banner year for nesting, over 2.6 young fledged from successful nests (Frederick et al. 2009). The greatest losses occur from egg laying to hatching with a 30 percent loss of the nest productivity. From hatching to nestlings of two weeks of age, nest productivity loss is an additional 8%. Corresponding losses for the remainder of the nesting cycles are on the average of a 6% per two week increase in age of the nestling (Rodgers and Schwikert 1997).

Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964; Kushlan et al. 1975) to sustain successful wood stork nesting. During the period when a nesting colony is active, wood storks are dependent on consistent foraging opportunities in wetlands within their core foraging area (30 kilometer radius, FWS 2010) surrounding a nest site. The greatest energy demands occur during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 201 kilograms (443 pounds) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). 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 percent and 8%, respectively from egg laying to hatching and from hatching to nestling survival to two weeks) (Rodgers and Schwikert 1997).

The annual climatological pattern that appears to stimulate the heaviest nesting efforts by wood storks is 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. This pattern produces widespread and prolonged flooding of summer marshes that maximizes production of freshwater fishes, followed by steady drying that concentrates fish during the dry season when storks nest (Kahl 1964; Frederick et al. 2009). However, frequent heavy rains during nesting can cause water levels to increase rapidly. The abrupt increases in water levels during nesting, termed reversals (Crozier and Gawlik 2004), may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success was reported to have affected most wading bird colonies in southern Florida during 2004, 2005 and 2008 (Crozier and Cook 2004; Cook and Call 2005; SFWMD 2008).

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 six months following fledging, most likely as a result of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006; Borkhataria et al. 2008). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects wood storks and their ability to forage (Hylton et al. 2006; Borkhataria et al. 2008).

In southern Florida, both adult and juvenile wood storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Wood 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 wood storks from southern Florida move far 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 wood storks have also been reported to move well beyond the breeding range of wood storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Both adult and juvenile wood 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 wood 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 wood 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 vast majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of wood storks in this region was 10 to 100 times higher than in northern Florida and Georgia (FWS, unpublished data). As a result of these general population-level movement patterns, during the earlier period of the wood stork breeding season in southern Florida, the wetlands upon which nesting wood storks depend are also being 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 wood stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

The original Everglades ecosystem, including WCAs, provided abundant primary and secondary wading bird production during the summer and fall months (Holling et al. 1994). This productivity was concentrated during the dry season when water levels receded. The concentrations of food provided ideal foraging habitat for numerous wetlands species, especially large flocks of wading birds (Bancroft 1989; Ogden 1994). However, the hydrology of the Everglades ecosystem and WCA-3A has been severely altered by extensive drainage and the construction of canals and levees (Abbott and Nath 1996). The resulting system is not only spatially smaller, but also drier than historical levels (Walters et al. 1992). Breeding populations of wading birds have responded negatively to the altered hydrology (Ogden 1994; Kushlan and Fohring 1986; Bancroft 1989).

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. These effects would result in relatively high abundance of wood stork prey because of high stages and long hydroperiods, and this prey would become available to wood storks at a rapid rate in the late dry season. Because IOP WCA-3A Regulation 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 would be limited in WCA-3A. The expected effect of this condition would be later initiation of nesting or reduced rates of nest initiation in those colonies closely associated with WCA-3A (*i.e.* L-28 Crossover, Jetport, and others). (2006 IOP FSEIS)

Within the vicinity of western ENP and lower Shark River Slough, 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 tended to result in early initiation of nesting within these areas, but the limited water deliveries into Shark River Slough 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 (2006 IOP FSEIS).

In most years within the vicinity of NESRS, IOP resulted in reduced stages during the dry season because of constraints on inflows. This may have caused increased recession rates in this area resulting in a reduction in the amount of suitable foraging habitat available near the end of wood stork nesting in the late dry season when stages in that area reached their lowest levels. In addition, reduced flows had the potential to result in the risk of drying below the Tamiami West wood stork colony potentially increasing nest depredation rates and risk of nest abandonment, particularly in drier-than-average years. The close proximity of the colony to the L-29 Canal helped to reduce the risk of drying below the colony because canal stages were maintained at a relatively stable level throughout the dry season.

Modeling also indicated that IOP would occasionally result in increased water levels in NESRS during the spring dry season (2006 IOP FSEIS). 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 wood stork colony, would rise by up to one foot during the period when wood storks were nesting and when water levels were generally receding throughout the system. This results in an artificial reversal and would cause a reduction in wood 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 and WCA-3B, ENP, the Pennsuco Wetlands, and urban areas, sufficient foraging opportunities remained in other areas to offset the poor foraging conditions that result from IOP in NESRS, but some reduction in foraging opportunities was expected.

On November 17, 2006, FWS issued a BO evaluating the past, current, and projected future impacts to the wood stork due to continued operation of IOP. In their 2006 BO, FWS concluded: "Impacts to wood stork foraging and nesting are likely to occur under IOP resulting from reductions in foraging habitat suitability and potential increased risk of depredation within some stork colonies. These effects are not expected to appreciably reduce the likelihood of survival and recovery of the species in the wild."

Since 1986, the USACE has funded a program with Peter Frederick, Ph.D. of the University of Florida 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 and to try to understand the environmental variables related to successful breeding. The program includes aerial surveys to identify locations of wading bird nesting colonies each year as they develop and to estimate the number of nests produced by each wading bird species. Ground surveys by airboat are conducted in colonies that contain wood storks to estimate nesting success (young fledged) in a sub-set of marked nests. Nesting effort (number of nests) of wood storks from 2002 to 2009 in the various named colonies in the WCAs and just south of WCA-3B in ENP is outlined in **Table 12** and summarized below.

TABLE 12: NUMBER OF WOOD STORK NESTS FROM 2002 TO 2009 IN THE IOP/ERTP ACTION AREA AS REPORTED BY DR. PETER FREDERICK AND ROSS TSAI, DEPARTMENT OF WILDLIFE ECOLOGY, UNIVERSITY OF FLORIDA AND THE SOUTH FLORIDA WADING BIRD REPORTS

Colony Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Tamiami East	0	0	0	0	0	0	0	35	15	0	0	5	0
Tamiami East 2	0	0	0	0	0	0	0	15	30	0	0	0	0
Tamiami West (NESRS)	350-400*	350-400*	50	200*	400	75-242	0	1,300	350	0	0	400	0
2B Melaleuca	0	0	0	0	0	0	n/a	n/a	0	0	0	0	0
Crossover (WCA-3A)	76*	40	150*	0	0	175	0	28	0	0	0	0	0
Jetport (WCA-3A)	550*	375	0	0	n/a	0	n/a	1,167	0	0	0	43	60
Mud East (WCA-3B)	0	0	100-130	20	15	0	0	7	0	0	0	0	0
Jetport South (WCA-3A)	n/a	n/a	29	0	n/a	0	n/a	238	0	350	0	463	400
Loxahatchee 1	0	0	4	0	n/a	n/a	n/a	21	0	0	0	0	0

Source: SFWMD 2002-2014
* Some nests successfully fledged young; where a range was reported, the average was used to calculate the total number of nests.
n/a = data not available.

Wood stork nesting success has been variable throughout IOP/ERTP operations and in several instances may be attributed to reversals that occurred as a result of heavy rainfall events. Monitoring efforts by Dr. Frederick and his research team have shown:

In 2002, wood storks had generally high nesting success at all colonies. The number of wood storks nesting within the WCAs was 2.9 times the average of the previous five years and 3.7 times the average of the previous ten years. Many large groups of juvenile storks were seen throughout early summer foraging in the WCAs, BCNP, and the EAAs.

In 2003, nesting effort in the WCAs was 2.1 times the average of the previous five years and 3.9 times the average of the previous ten years, but large numbers of these nests were abandoned. These failures can be attributed in large part to heavy rainfall, particularly in late March. The nest success rate at Tamiami West was 31% lower than in 2002, generally occurring early in the nesting season, during March.

In 2004, wood storks initiated nesting somewhat late even by the standards of the previous 20 years, and these birds began abandoning nests in response to heavy rainfall in early March. However, there was no evidence of abandonment at the Crossover colony, and the birds there appeared to have fledged substantial numbers of young.

In 2005, nests were largely unsuccessful as a result of stable or rising water levels during March due to unseasonable rainfall. Tamiami West had a maximum of 25-35 successful nests.

In 2006, wood storks experienced a bumper year for nesting within the WCAs and ENP. It was the best year since 2002 at the Tamiami West colony. Approximately 400 nests were located at this colony with a nest success rate of 0.72 and an average of 2.58 chicks fledging per nest. Late summer rainfall in 2005 resulted in high water stages within WCA-3A. In the fall of 2005 rapid drying occurred throughout the season and was essentially uninterrupted during the wood storks nesting season with the exception of two rainfall events in 2006. The abundance of water and rapid recession rates created essentially perfect conditions for high prey availability during much of the breeding season contributing to the high number of successful nests.

In 2007, the numbers of nests and nest success were below average with no pairs attempting to nest in the water conservation areas. Nest success was well below historical averages with 1.37 chicks per successful nests and 0.57 chicks fledged per nest starts. This level is well below the level considered necessary for either demographic replacement or for recovery of the species. During the winter and spring of 2007, water levels were relatively low. This coupled with a general lack of rainfall and drying conditions is generally associated with good foraging conditions and above average nesting. However, fish sampling efforts indicated that food was not very abundant. The favorable foraging conditions produced by the low water levels and recession rate, however, could not overcome the reduced standing stocks of fish and aquatic macroinvertebrates necessary for successful reproduction.

In 2008, no wood stork nests were successful anywhere within the Everglades with all nests abandoned by mid-May. This poor performance was not surprising given the weather and water conditions preceding and during the breeding season. The drier than usual wet season of 2007 created suboptimal conditions for the production of fish and aquatic macroinvertebrates. Unseasonable rainfall in February, March and April of 2008 led to stable or increasing water stages, low or negative foraging rates in most pools and generally poor foraging conditions.

In 2009, wood stork nest numbers were exceptionally high with a 14.5 fold increase over the previous five-year average and a four-fold increase above the ten-year average. In fact, wood stork numbers were the highest recorded since 1975. Nest starts experienced a greater than 75% chance of fledging at least one young, and successful nests produced over 2.6 young each. Relatively high water levels in 2008 favored ample production of fish and aquatic macroinvertebrates. The abundance of prey in conjunction with a long and continuous period of drying (September 2008 through May 2009) contributed to the high nest success rate in 2009. In addition, the high numbers may be attributed to the number of young birds produced during the bumper 2006 season that had just reached breeding age or from storks from outside the region that were attracted by the favorable conditions.

In 2010, there was no wood stork nesting in the WCAs. As a result of a strong El Niño event, the 2010 nesting season (November 2009 – July 2010) was exceptionally cold with numerous rainfall events during the normally dry season, causing widespread reversals in the drying trend of water. As a result, recessions that normally produce water depths appropriate for foraging were interrupted, resulting in near-flat pool conditions in much of the WCAs until late March (Frederick 2010). In addition, cold temperatures likely affected fish and invertebrate availability to birds, with daily low temperatures below thresholds for burrowing and hiding behavior in fishes on 62% of days, and daily mean temperatures below this on 23% of days (Frederick 2010). Therefore, in comparison with previous years, 2010 was an exceptionally low year in terms of numbers of nests and nesting success.

In 2011, wood stork nesting was considered marginally successful with a similar number of nest starts as the 10 year average; however, nest success rate was poorer as compared with the ten year average. Wood stork nest initiation occured later in 2011 than any other season since 1998, occuring in mid to late March. Although recession rates seemed favorable early in the nesting seaso, the late initiation suggests a lack of a sufficient prey base or perhaps better conditions elsewere (Frederick 2012). While wood stork nest success in Tamiami West was reasonably high (43%), and brood size was quite high (3.07), it is important to note that the colony at Jetport South failed entirely and nest success was essentially zero. It is unclear why the storks abandoned at Jetport, though food sources on the west side of the WCAS may have dried up earlier than on the east side, based solely on elevation gradients. If storks nesting in freshwater (ENP and WCAs) are tallied together (870 nests), 470 were known to have failed at Jetport South, and 228 of those at Tamiami are estimated to have failed. This indicates that almost 80% of all the stork nests in freshwater marshes failed in 2011. (Frederick 2011).

In 2012, no wood storks initiated nesting in the WCAs; however, wood storks did nest within ENP. The 2012 season had above average water levels throughout the system for the most of the season. Despite strong recession rates (>60% 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 limits nest success by decreasing prey availability. It is believed almost all nests failed due to heavy rains before fledging any chicks.

In 2013, 506 nests were initiated within WCA-3A, which is 56% above the ten year average (Frederick 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 in drying trend due to rain starting in mid-April pushed water levels up well above average. High water levels during the dry breeding season generally limit nest success by decreasing prey availability. Nesting success was variable between colonies and on average there were 2.00 fledglings per successful nest. A successful nest is defined as one in which the young were raised until day 50. (Frederick 2013).

In 2014, 497 wood stork nests were initiated within WCA-3A, which is 69% 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 the 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. A successful nest is defined as one in which the young were raised until day 50.

In summary, wood stork nesting success during the eleven breeding seasons (2002-2012) since IOP implementation was mixed, with meteorological events overcoming any hydrological effects of water management operations. ERTP was implemented in October 2012, therefore, there have only been two full wood stork nesting seasons since implementation included within this assessment since 2015 data is not yet available. Since ERTP was implemented there has been a 2% and 69% increase in 2013 and 2014 respectively, in the number of wood stork nests initiated within WCA-3A. Additional data are needed to discern whether the increase is related to improved water management operations under ERTP (recession rates/water depths) or whether the apparent increase is related to the increase in abundance of the breeding population.

5.5.10.1 POTENTIAL EFFECTS ON WOOD STORK

USACE recognizes that until completion of CERP there are few opportunities within the current constraints of the C&SF system to completely avoid effects to listed species. Although the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the previous operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the threatened wood stork and other wading bird species.

The major components of ERTP that potentially may affect wood stork (and other wading bird species) include WCA-3A Interim Regulation Schedule and modifications of the IOP restriction dates on the S-12C structure. Rainfall Plan Target Flows, S-346 and S-332D operations and Pre-storm, Storm, and Storm Recovery Operations for the SDCS will have little impact on the wood stork. In addition, the WCA-3A PSC will 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. A detailed evaluation of these ERTP components is included within the October 2010 ERTP Biological Assessment and is hereby incorporated as reference (**Appendix A**). This section of this Supplemental Biological Assessment will explore potential effects of the five main reasonable and prudent measures under USACE authority identified during informal consultation that may act to further protect CSSS. These include 1) MWD Project Increment 1 Field Test; 2) implementation of operational flexibility within ERTP to protect CSSS; 3) a Water Flow Analysis Test; 4) MWD Increment 2 Field Test; and 5) Combined Operational Plan (i.e. MWD Increment 3). In addition, USACE will prepare an assessment, using an interagency team, of potential effects of Levee 28 (L-28) Borrow Canal flows into western CSSS-A habitat. Results from this assessment could be used to recommend further action; however, USACE has not yet determined what authority might be required for such action. It is important to note as described within Section 4.10 and Section 4.11, affects on listed species as a result of implementation of MWD Increment 2 and COP will be detailed under separate ESA consultation and thus are not assessed within this Supplemental Biological Assessment.

5.5.10.1.1 MWD INCREMENT 1 FIELD TEST

Wood stork colonies exist directly adjacent to Tamiami Trail and within NESRS. Tamiami Trail East 1 (TT-East), TT-East 2, TT-West, and Grossman's Ridge West all occur within the main action area for the MWD Increment 1 Field Test (
Figure 27). 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, rehydrating historic wetlands. During the field test, the stage elevation 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. 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 SDCS that was conducted using the historical period from July 2002 (initial IOP operations) through June 2014 (start of Increment 1 development). Over this cumulative historical hydrologic analysis period, MWD Increment 1 Field Test would be expected to increase the number of unconstrained discharges from WCA-3A to NESRS by up to 1,176 days, a 64% increase relative to ERTP, with the majority of increased flows to NESRS anticipated during the months of June through December. A potential increase in hydroperiods within NESRS may provide an overall net benefit for wood stork foraging suitability by maximizing production of freshwater fishes. Monitoring of optimal foraging depths and recession rates for this species is being proposed as part of MWD increment 1 Field Test, (reference **Appendix C**). Since the foraging radius of TT-East 1, TT-East 2, TT-West and Grossman's Ridge West includes parts of WCA-3A, WCA-3B, ENP, and the Pennsuco Wetlands, sufficient foraging opportunities are anticipated to remain in other areas to offset any poor foraging conditions that may result from the field test; however, it is not anticipated that such conditions would occur. Potential reductions in wood stork foraging conditions and colony abandonment due to artificial reversals at the end of the dry season/start of the wet season is also not anticipated as a result of field test implementation. Historically, wood stork nesting started around November-December, but in recent decades it has shifted to January-March. Additional water being delivered to NESRS is also only expected to occur during the wet season when areas

are already anticipated to be inundated. Potential increases are expected to occur during the wet season. Based on this information and the limited duration of the field test, USACE has determined that implementation of the MWD Increment 1 Field Test may affect, but is not likely to adversely affect, this species. The USACE will continue to implement PSC as outlined within the 2011 ERTP Final EIS and will include assessment of conditions within the project area to ensure wildlife recommendations are considered during the water management decision process. FWS concurrence on this determination was received on February 10, 2015 and reconfirmed on May 22, 2015. For detailed information and evaluation of potential effects on this species due to implementation of MWD Increment 1 Field Test, along with pertinent correspondence, please refer to **Appendix C**.

5.5.10.1.2 OPERATIONAL FLEXIBILITY WITHIN ERTP

As previously discussed, water levels within portions of WCA-3A (e.g. southwestern 3A) have been too high for too long resulting in detrimental effects to vegetation and wood stork foraging. Under the ERTP, the WCA-3A Interim Regulation Schedule Zone A was lowered by 0.25 feet (*i.e.* 9.75 to 10.75 feet NGVD under IOP versus 9.50 to 10.50 feet NGVD under ERTP), thereby lowering the trigger stage for water releases from WCA-3A. By providing an additional mechanism to reduce high water levels within WCA-3A, modifications to the WCA-3A Interim Regulation Schedule under ERTP have the potential to provide beneficial effects to the wood stork and its habitat within WCA-3A.

Water depth and recession rate are the two most important hydrological variables for wood storks (Gawlik et al. 2004). In their analysis of habitat suitability, Gawlik et al. (2004) identified feeding sites where the weekly average water depths from November to April (pre-breeding and breeding season) were between 0.0 and 0.5 feet as the most suitable. Suitability drops to 0.0 when water depths are -0.3 feet below marsh surface or greater than 0.8 feet. Continued implementation of ERTP WCA-3A Interim Regulation Schedule is expected to produce a mosaic of wetland habitats within WCA-3A that will provide favorable foraging opportunities for wood storks. Since ERTP was implemented in October 2012, there have been two breeding seasons in which water management operations included the flexibility provided by the WCA-3A regulation schedule as well as the allowance of flows through S-12C structure to assist to reduce water depths within WCA-3A. In addition, the incorporation of PM-G into ERTP addresses wood stork foraging depth requirements particularly within the highly important marshes of their core foraging area during the breeding season. As reported in ERTP Annual Assessments for Water Year 2013 (October 1, 2012 through September 30, 2013) and Water Year 2014 (October 1, 2013 through September 30, 2014), PM-G was attained throughout much of the nesting season within WCA-3 (**Figure 28** through **Figure 31**).

As illustrated in **Figure 28**, 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. However, undesirable water depths at Gauge 3A-3 and 3ASW occurred between October and December 2012 and after mid-July, outside the peak nesting season. 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 Water Year 2013. In WCA-3B, water depths at Gauge 3B-2 were appropriate for wood stork foraging throughout much of Water Year 2013, with the exception of periods during October through December 2012 and mid July through

September 2013 (**Figure 29**). Depths experienced at Gauge 3BS1W1 were deeper than those required to support foraging wood storks throughout much of Water Year 2013 with the exception of mid-February through late May 2013. As shown in **Table 13**, two reversals occurred due to rainfall events during the week ending April 21, 2013 and again during the week ending May 5, 2013. Between November 2012 and February 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.

As illustrated in **Figure 30** and **Figure 31**, 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. Appropriate foraging depths were experienced between late November 2013 and September 2014 at Gauge 3A-3, November 2013 through late May 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 March 2014. In WCA-3B, water depths at Gauge 3B-2 were appropriate for wood stork foraging Between March and August 2014 (**Figure 31**). 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. As shown in **Table 14**, a reversal occurred due to rainfall events during the week ending February 3, 2014 and again during the week ending June 2, 2013, signaling the onset of the rainy season.

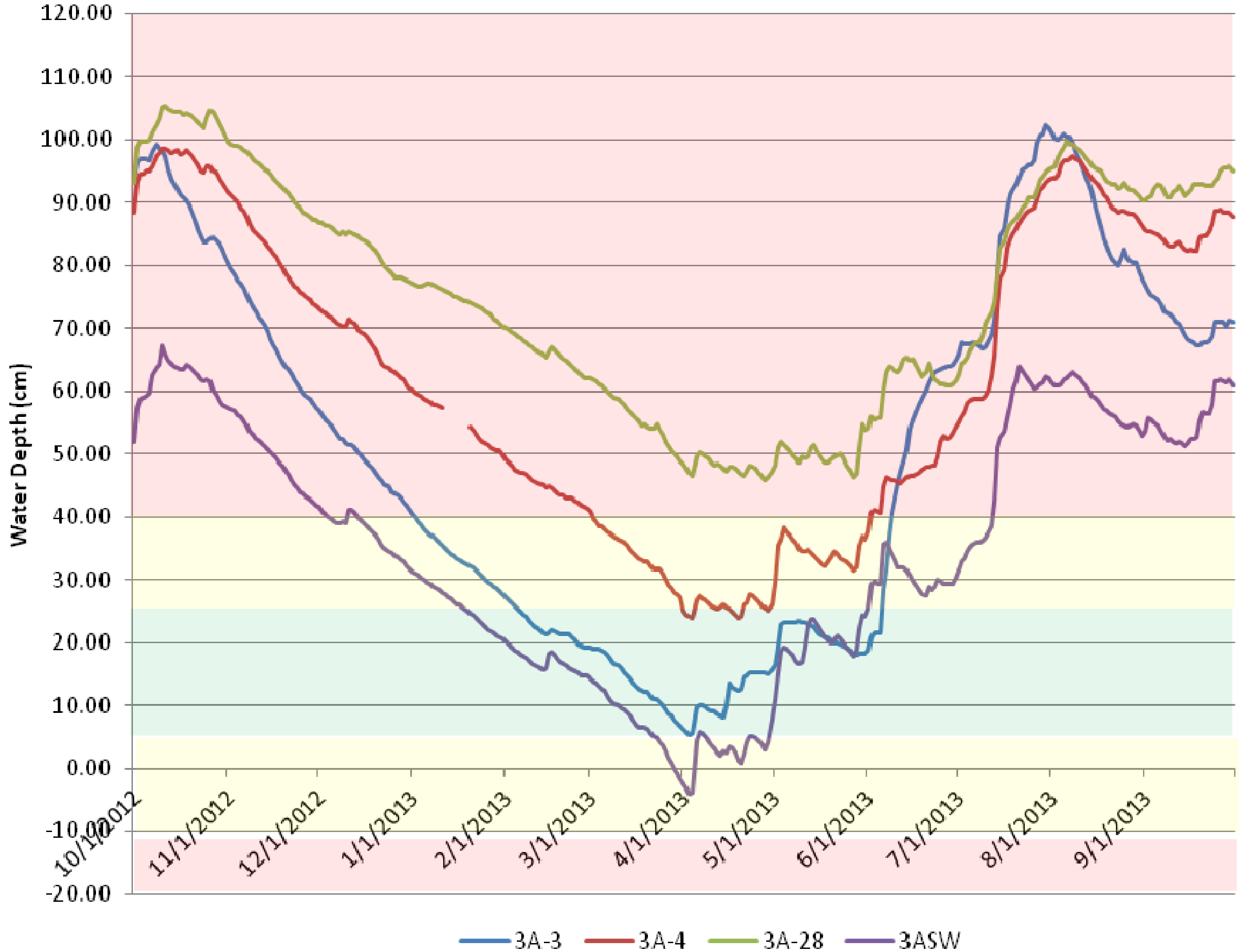


FIGURE 28. WOOD STORK FORAGING DEPTHS WITHIN WCA-3A DURING WATER YEAR 2013 AS MEASURED AT GAUGE 3A-3, GAUGE 3A-4, GAUGE 3A-28 AND GAUGE 3ASW

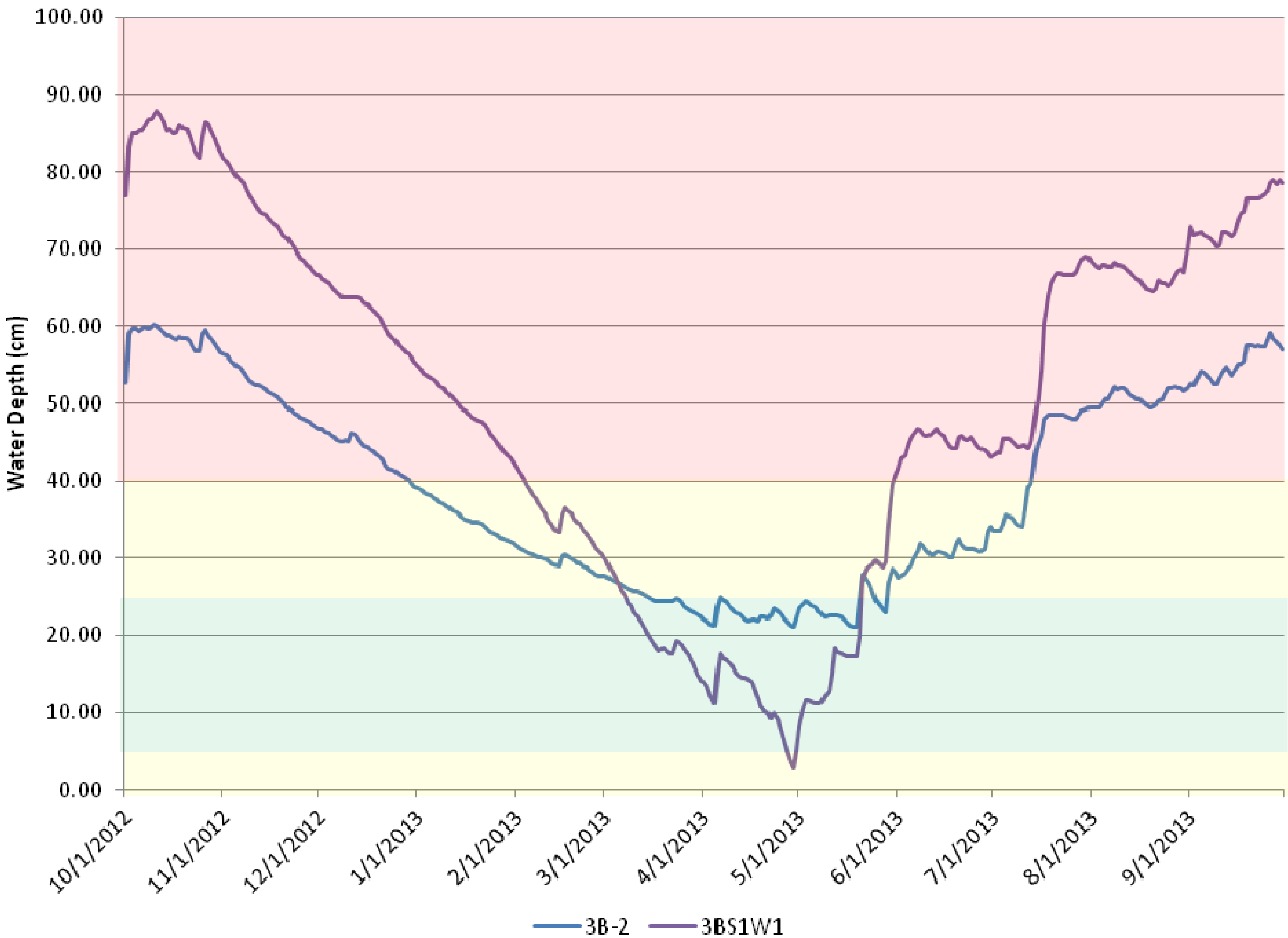


FIGURE 29. WOOD STORK FORAGING DEPTHS WITHIN WCA-3B DURING WATER YEAR 2013 AS MEASURED AT GAUGE 3B-2 AND GAUGE 3BS1W1

FIGURE 30. WOOD STORK FORAGING DEPTHS DURING WATER YEAR 2014 WITHIN WCA-3A AS MEASURED AT GAUGE 3A-3, GAUGE 3A-4, GAUGE 3A-28 AND GAUGE 3ASW

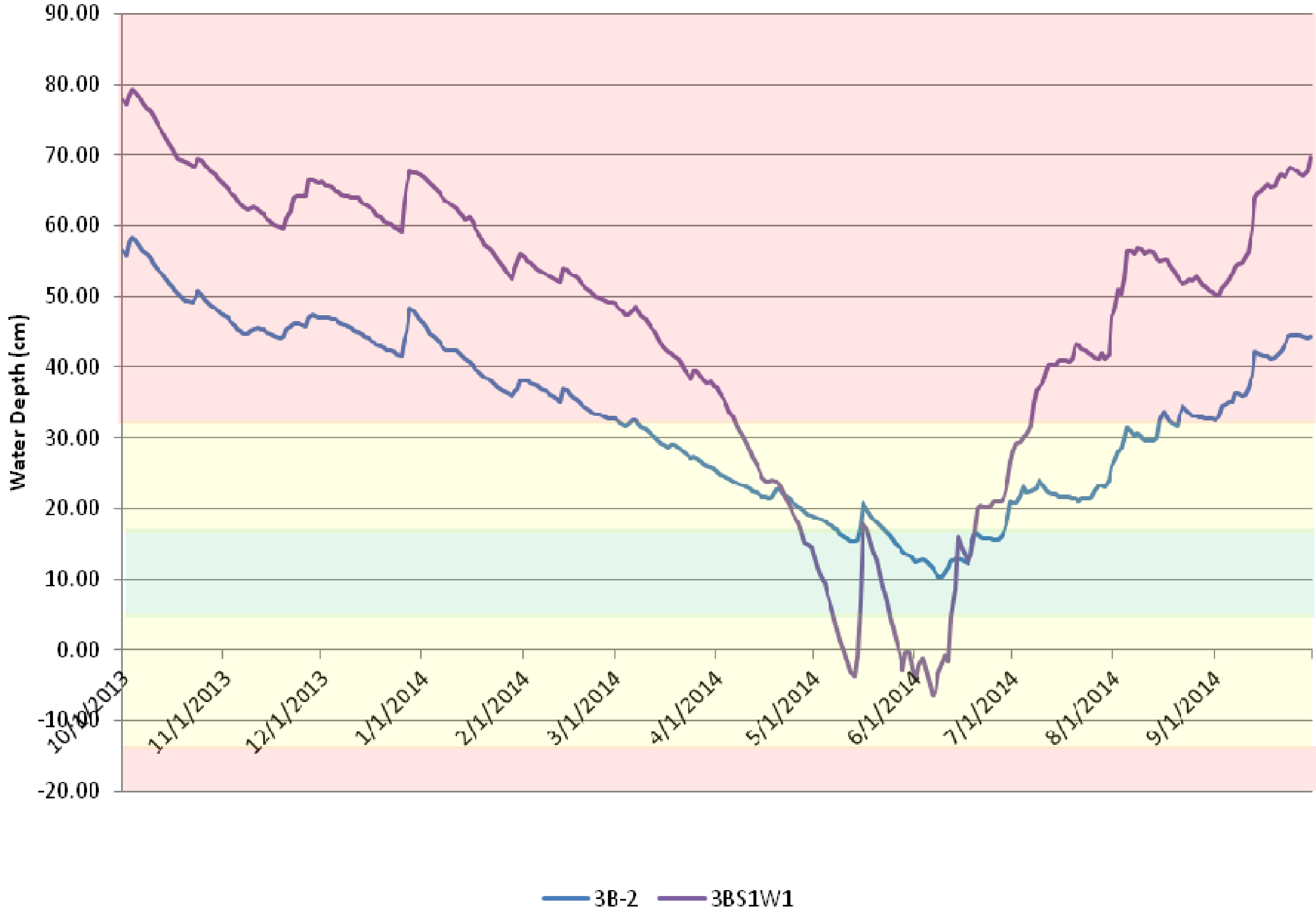


FIGURE 31. WOOD STORK FORAGING DEPTHS WITHIN WCA-3B DURING WATER YEAR 2014 AS MEASURED AT GAUGE 3B-2 AND GAUGE 3BS1W1

Under IOP WCA-3A Regulation Schedule recession rates were 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 condense their prey items into shallow pools for more effective foraging. On the other hand, too rapid drying conditions if repeated year after year would soon reduce the prey base required for successful breeding (Fleming et al. 1994). ERTP 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). ERTP recommended recession rate for wood storks and other wading birds is 0.06 to 0.07 feet per week from January 1 to June 1. The recession rate for any given week or period of time will be determined based upon recommendations made during the WCA-3A PSC. As previously described, in order to meet WCA-3A PSC recommended recession rates for any given period, USACE will utilize the operational flexibility inherent within ERTP to achieve the recommendation.

Observed weekly recession rates during the two breeding seasons (2013, 2014) in which water management operations were as described within ERTP are illustrated in **Table 13** and **Table 14**. During Water Year 2013 and Water Year 2014, recession rates for wood storks and wading birds, particularly within the early dry season were within, or near the preferred range. Reversals due to rainfall events were also experienced during both water years. In 2013, reversals were experienced during late April and early May with a reported reversal on May 5, 2013 of 0.28 feet/week. In 2014, reversals were experienced during early February and late May with a reported reversal on June 2, 2014 of 0.10 feet/week. In the Water Year 2013 and Water Year 2014 ERTP Annual Assessments, USACE conducted a retrospective review to determine the potential cause(s) of recession rates outside the preferred range experienced during the 2014 dry season (*i.e.* January 1 through June 1 2014) and how future operations can avoid exceeding these thresholds. Please refer to **Appendix B**. USACE 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 attributed to evapotranspiration rates. However, there may be some additional opportunities to use operational flexibility and preemptive releases in particular to assist to attain recession rates within the preferred range for wood storks and other wading birds. It is also important to note the balancing act between wood storks, wading birds and snail kites, in meeting recommended recession rate targets as snail kite prefer a slower recession rate.

TABLE 13. 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

* Note: Numbers are highlighted to correspond to FWS MSTS stoplight key below (FWS 2010).

TABLE 14. 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

* Note: Numbers are highlighted to correspond to FWS MSTS stoplight key below (FWS 2010).

FWS 2010 Key:

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

Continued implementation of ERTP with associated lowered water levels in WCA-3A may affect wood storks by potentially increasing the number of areas with sufficient depths for foraging; thereby increasing foraging opportunities within WCA-3A. Lowering of water levels may also reduce hydroperiods within some areas of WCA-3A. Since fish densities vary with the duration of the hydroperiod, this could potentially affect wood stork foraging and nest productivity. For instance, research on Everglades fish populations has shown that the density of small forage fish increases with hydroperiod: marshes inundated for less than 120 days average ± 4 fish/m^2; whereas those flooded for more than 340 days of the year average ± 25 fish/m^2 (Loftus and Eklund 1994; Trexler et al. 2002). ERTP ET-3 also provides for a 1 in 4 or 1 in 5 year dry down to promote regeneration of marsh vegetation. This provision in concert with the lowering of WCA-3A water levels will help to ensure healthy marsh vegetation as well as act to promote forage fish abundance through predator release and increased nutrient availability. The S-12C restriction date modification, however, will likely not produce a substantial decrease in hydroperiods within WCA-3A to significantly affect fish densities. In addition, as wood storks rely upon a variety of wetland types of differing hydroperiods throughout the year, restriction date modifications under ERTP may help to maintain a network of suitable foraging conditions both within WCA-3A and ENP.

Historically, the short hydroperiod wetlands within ENP have been important for wood stork foraging during the pre-breeding season with the storks shifting to longer hydroperiod wetlands as the dry season progresses. ERTP ET-2 provides for a hydroperiod requirement between 90-210 days within CSSS habitat and thus would help to produce a mosaic of wetlands of varying hydroperiods within ENP. In addition, operational flexibility within ERTP with regard to prioritizing releases through the S-332 structures to maintain CSSS required hydroperiod will directly benefit wood storks foraging within C-111 South Dade and Taylor Slough. Hydrological patterns that produce a maximum number of patches with high prey availability (*i.e.* high water levels at the end of the wet season and low water levels at the end of the dry season) are necessary for high reproductive outputs (Gawlik 2002; Gawlik et al. 2004). Depending upon the elevation and microtopography throughout the WCAs and ENP, implementation of ERTP will produce a variety of wetland habitats that would support prey densities conducive to successful wood stork foraging and nesting.

5.5.10.1.3 WATER FLOW ANALYSIS TEST

The proposed Water Flow Analysis Test will allow for a better understanding of directionality of flow entering CSSS-A habitat to determine whether additional operational modifications to the S-12A, S-12B, S-343A, S-343B and S-344 structures or other additional measures may be needed to prevent western flows into CSSS-A. USACE has determined that the Water Flow Analysis Test will have no effect on wood stork. If the results of the Water Flow Analysis Test indicate that flows from sources other than the S-12A, S-12B, S-343A, S-343B or S-344 structures have a negative effect on CSSS-A, there may be future opportunities to limit restriction dates on these structures; thereby benefitting wood stork by having additional outlet capacity to reduce high water conditions within WCA-3A. Any reasonable and prudent measures that result from information gained through the Water Flow Analysis Test will be addressed through separate ESA consultation with FWS and any effects on wood stork will be described within a future Biological Assessment.

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.

5.5.10.1.4 L-28 BORROW CANAL

The USACE will prepare an assessment, using an interagency team, 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, USACE 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 multiagency team to include FWS, 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. This effort will require authorization, NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of L-28 Borrow Canal options within this Supplemental Biological Assessment. Since at this point this reasonable and prudent measure is solely an assessment, USACE has concluded that any L-28 Borrow Canal Planning Study will have no effect on wood stork.

5.5.10.2 SPECIES EFFECTS DETERMINATION

Wood storks forage and nest within ERTP action area. ERTP proposed modifications to IOP regulations 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 favorable recession rate during the breeding season. In addition, ERTP includes specific water depth targets and recession rates aimed at improving nesting and foraging conditions for the wood stork (**Figure 26**). Hydrological changes associated with continued implementation of the action are expected to alter and slightly improve some of the physical and biological features essential to the nesting and foraging success of the species. Although the action related hydrological changes are expected to be minimal, USACE has determined the action may affect wood stork thus is requesting formal consultation under ESA. However, these changes represent improvements over IOP operational regime. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring will benefit the species.

6 CONSERVATION MEASURES

USACE acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within ERTP action area. In recognition of this, disturbance to listed species will be minimized or avoided by implementing FWS MSTS and striving to attain water levels and recession rates as described therein.

In addition, species and habitat monitoring will continue to identify population trends for the CSSS, snail kite, wood stork and the vegetation characteristic of their habitats. WCA-3A PSC will allow USACE and its Tribal and Governmental partners to discuss ecological, hydrological, meteorological, and multiple species conditions to achieve ERTP objective of managing water levels and releases for the protection of multiple species and their habitats. Finally, USACE also proposes to implement habitat management guidelines for the wood stork and the standard Florida manatee and Eastern indigo snake protection measures established by FWS.

In addition to the reasonable and prudent measures evaluated within this Supplemental Biological Assessment, as a result of informal consultation on ERTP, CEPP and MWD Project Increments, USACE identified several potential reasonable and prudent measures that may assist to enhance CSSS resiliency. Many of these items fall outside USACE authority, therefore, USACE suggests that FWS further investigate the following near term (6-12 months), mid-term (2-5 years) and long-term (5+ years) options identified within **Table 15** and consult with the appropriate agencies that have authority to implement the identified measures. Please note these items are in addition to items already indentified within the Department of the Interior CSSS MOU. USACE is committed to work diligently with FWS to implement reasonable and prudent measures under USACE authority in accordance with 7(a) (2) of the Act.

TABLE 15. POTENTIAL CONSERVATION MEASURES THAT MAY ASSIST TO ENHANCE CSSS RESILENCY. NOTE: ACTIONS IDENTIFIED WITH AN ASTERISK INDICATE ACTIONS OUTSIDE USACE AUTHORITY

Time Frame^	Conservation Measure	Conservation Measure Description	Notes
Near-Term	Plugging of Old Tamiami Trail Borrow Canal*	This measure consists of placing a plug within the Old Tamiami Trail Borrow Canal between the S-12B and S-12C structures in order to reduce flow into western Shark River Slough where Cape Sable seaside sparrow, subpopulation A resides.	This action was originally identified in the Everglades Restoration Transition Plan Final Environmental Impact Statement as a Department of the Interior action, and National Environmental Policy Act compliance was completed in October 2012. Please refer to the Everglades Restoration Transition Plan Final Environmental Impact Statement and **Appendix H**, specifically, for further details. This action has not been implemented to date.
	Removal of Vegetation Halos*	This measure consists of removal of vegetation halos downstream of the Tamiami Trail culverts in order to enhance conveyance of water into Everglades National Park. This measure also includes vegetation management (clearing) within the footprint of the Tamiami Trail Next Steps Project bridges.	Removal of vegetation halos downstream of the Tamiami Trail culverts as well as downstream of the S-12 structures has been discussed for many years as a way to increase conveyance of water into Everglades National Park. According to Everglades National Park personnel this measure has been overcome by construction of Tamiami Trail Modifications Project (1-mile bridge) completion as well as future construction of the Tamiami Trail Next Steps Project 2.6 miles of bridging. This conservation measure would be responsibility of ENP.
	Sea Level Rise	This measure consists of a sea level rise analysis in order to determine potential habitat suitability for habitation by Cape Sable seaside sparrow under future sea level rise scenarios.	U.S. Army Corps of Engineers is currently working in conjunction with U.S. Fish and Wildlife Service to complete this analysis. Once completed, the information can be used to prioritize habitat management actions within future Cape Sable seaside sparrow habitat.
Mid-Term	Gapping/Removal of Old Tamiami Trail*	The Old Tamiami Trail represents an impediment to water flow within Everglades National Park. Gapping/removal of Old Tamiami Trail will enhance sheetflow across Everglades National Park and allow for increased outlet capacity from Water Conservation Area 3A.	Florida Fish & Wildlife Conservation Commission is currently coordinating with Everglades National Park on potential options to gap/remove Old Tamiami Trail. It is also important to note that the Central Everglades Planning Project Recommended Plan includes removal of Old Tamiami Trail. However, Central Everglades Planning Project has not yet been authorized by Congress and thus, at this time, U.S. Army Corps of Engineers does not have authority to implement this measure. Once Central Everglades Planning Project is authorized and funds appropriated, U.S. Army Corps of Engineers will revisit this measure in a future Endangered Species Act consultation, as needed.
	MWD Real Estate Acquisitions*	Acquisition of private property along Tamiami Trail as described within the 1992 Modified Water Deliveries to Everglades National Park General Design Memorandum will allow an increase in Levee 29 Canal Stage to further facilitate flows through the historic flow path into Northeast Shark River Slough and thus away from Cape Sable seaside sparrow, subpopulation A.	The 1992 Modified Water Deliveries Project General Design Memorandum identified 7 parcels along Tamiami Trail that would require flowage easements as a result of Modified Water Deliveries Project Implementation. U.S. Army Corps of Engineers is slated to acquire the necessary real estate interests in order to flow water over the Airboat Association property in 2016. The Department of the Interior has indicated that the remaining parcels would be acquired by 2016.
	L-28 Borrow Canal	This measure consists of implementation of recommendations from the L-28 Borrow Canal Planning effort to identify alternative to address flows associated with Levee 28 Borrow Canal.	The U.S. Army Corps of Engineers will prepare an assessment, using an interagency team, of potential effects of Levee 28 Borrow Canal flows into western Cape Sable seaside sparrow, subpopulation A. Results from this assessment could be used to recommend further action, but the Corps has not yet determined what authority might be required for such action.
	Jetport*	Miami Jetport currently represents an obstruction to flows moving further west within Big Cypress National Preserve, directing water south along the L-28 levee and Tamiami Trail borrow canal into Everglades National Park. The Jetport was identified as a possible contributing factor to flows within subpopulation A as early as 2006 and again in the 2007 Avian Panel convened by U.S. Fish & Wildlife Service.	The Jetport is approximately 1 mile in length and is owned by Miami-Dade County. As part of the original design, the recommended plan included culverts under the Jetport, however, U.S. Army Corps of Engineers is unclear as to whether these culverts are maintained. U.S. Army Corps of Engineers suggest U.S. Fish and Wildlife Service coordinate with Miami-Dade County as well Florida Fish and Wildlife Conservation Commission, who has management responsibilities for natural areas in this region, to assess effects to Cape Sable seaside sparrow, subpopulation A and implement any recommended measures that result from the assessment.
	Modified Water Deliveries Increment 2 Field Test	This measure primarily consists of raising Levee 28 Canal constraint to facilitate additional flow into Everglades National Park. Modified Water Deliveries Increment 2 Field Test will utilize information gained through Modified Water Deliveries Increment 1 Field Test.	As part of the Modified Water Deliveries Increment 2 Field Test, U.S. Army Corps of Engineers will include evaluation of changes to S-332B, S-332C and S-332D operations in order to enhance conditions for eastern Cape Sable seaside sparrow subpopulations. In addition, relaxation of the Levee 29 canal constraint (above 7.5 feet, National Geodetic Vertical Datum); will further facilitate flow into Everglades National Park through Northeast Shark River Slough. In addition, U.S. Army Corps of Engineers will further evaluate potential restrictions on the S-12 structures in light of available preliminary results of the Baseline and results from the Water Flow Analysis. Implementation of a multiagency team planning effort is currently scheduled to commence in April 2016 (**Appendix E**). This effort will require additional National Environmental Policy Act documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations.
	Pilot Swales*	This measure consists of construction of pilot swales downstream of the Tamiami Trail culverts in order to enhance conveyance of water into Everglades National Park.	Pilot swales were previously proposed south of Tamiami Trail near adjacent culverts (between S-333 and S-334). Prior studies suggested up to 250% potential increase in flows. National Environmental Policy Act documentation was completed by ENP; however, the action was not pursued under MWD Project as a result of funding constraints as well as DOI pursuit of Tamiami Trail Next Steps Project.
	Levees/Sheet pile Weirs*	This measure consists of constructing levees or sheet pile weirs within Cape Sable seaside sparrow, subpopulation A habitat to impede water flow into this area to benefit sparrows.	Constructing levees or sheet piles weirs within designated wilderness areas with Everglades National Park would require congressional authorization.

	Decomp Physical Model (DPM)/S-355s	This measure consists of utilization of DPM in conjunction with the S-355A and S-355B structures in order to flow water from Water Conservation Area 3A into Water Conservation Area 3B and ultimately, Northeast Shark River Slough.	Increased utilization of Water Conservation Area 3B to facilitate flow from Water Conservation Area 3A into Everglades National Park's Northeast Shark River Slough would assist to reduce high-water stages within Water Conservation Area 3A and thereby potentially reduce need for outflow through the S-12A and S-12B structures. Currently, Decomp Physical Model is a temporary feature and is slated for removal at the end of its testing period in 2017. Operational testing of the DPM began on November 5, 2013. The Corps is proposing a third year of testing in 2015 (October 2015 – January 2016), with the potential for a fourth year of testing in 2016 (October 2016 – January 2017). A Supplemental Finding of No Significant Impact (FONSI) was signed by the Jacksonville District Commander on July 8th, 2015. It is important to note that additional operational testing beyond 2017 will require additional evaluation under NEPA and acquisition of Clean Water Act permits.
Long-Term	Seepage Barrier/Adjustments to L-28	This measure consists of constructing a seepage barrier along the Levee 28 near 40-50 mile Bend.	Results of the Water Flow Analysis Test, as described within this Supplemental Biological Assessment, will be used to determine whether structural measures, potentially including a seepage barrier, are necessary to reduce western flows into Cape Sable seaside sparrow, subpopulation A.
	Levee 67 Extension Degrade	This measure consists of degrading the L-67 Extension to facilitate movement of water south into Everglades National Park.	Increased stages east of the Levee 67 Extension Levee (in the vicinity of Gauge Shark River Slough-1), as a result of levee degradation, would be expected to shunt into the Blue shanty Canal (i.e. a preferential flow pathway towards the Levee 29 Canal) and consequently raise stages in the Levee 29 Canal. This could cause a potential real estate concern as the U.S. Army Corps of Engineers and Department of the Interior are still working on acquiring real estate south of Tamiami Trail, and the maximum operating limit of the Levee 29 Canal is currently 7.5 feet National Geodetic Vertical Datum. A backwater effect on the Levee 29 Canal would also increase the possibility of hitting the S-333 (and S-356 during the planned Modified Water Deliveries Increment 1 field test) Levee 29 Canal constraint of 7.5 feet National Geodetic Vertical Datum sooner, which would decrease the capability to discharge from Water Conservation Area 3A to Northeast Shark River Slough. The Central Everglades Planning Project Recommended Plan includes additional Levee 67 degrade, pending the results of further engineering analysis regarding potential adverse effects on WCA-3A high water levels; however, it is important to note that Central Everglades Planning Project has not yet been authorized by Congress and thus at this time, U.S. Army Corps of Engineers does not have authority to implement this measure. Once Central Everglades Planning Project is authorized and funds appropriated, U.S. Army Corps of Engineers will revisit this measure in a future Endangered Species Act consultation.
	Combined Operational Plan: Modified Water Deliveries Project Increment 3	This measure will result in development of a Water Control Plan for the constructed features of the Modified Water Deliveries to Everglades National Park and Canal 111 South Dade Projects.	As part of the Combined Operational Plan, U.S. Army Corps of Engineers will evaluate potential water management operational changes to include structure operations, Rainfall Plan calculations and changes to the Water Conservation Area 3A Regulation Schedule based upon BAMM results. Operating plan scope and model tool development is scheduled to be initiated in September 2015 with implementation of a multiagency team planning effort currently scheduled to commence in July 2017 in order to include data obtained through MWD Increment 1 and Increment 2 Field Tests (**Appendix E**). This effort will require additional NEPA documentation as well as subsequent consultation under ESA and all other applicable environmental laws and regulations. As such, USACE has not evaluated implementation of COP within this Supplemental Biological Assessment.
	Broward County Water Preserve Area	This measure consists of construction of the Broward County Water Preserve Area Project, a component of the Comprehensive Everglades Restoration Plan.	Completion of this project will result in water quality improvements that will assist to provide additional water flow into Everglades National Park. The Canal 11 Impoundment component of this Comprehensive Everglades Restoration Plan Project is currently undergoing design and is expected to be advertised for construction award in Summer 2016.
	S-333/S-356	This measure consists of enhancing capacity of S-333/S-356 to allow additional flow into Northeast Shark River Slough as envisioned under Central Everglades Planning Project.	The Central Everglades Planning Project Recommended Plan includes the component to increase the capacity of S-333 and S-356. Capacity of S-356 would be increased to mitigate for increased seepage as a result of increased flows from increased capacity at S-333. Central Everglades Planning Project water quality language could be used as a framework to address potential water quality concerns related to the Everglade Settlement Agreement. It is important to note that additional capacity/utilization of S-333 would require real estate acquisition to be completed by the Department of the Interior in order to relax the Levee 29 constraint from 7.5 feet National Geodetic Vertical Datum. It is also important to note that Central Everglades Planning Project has not yet been authorized by Congress and thus at this time, U.S. Army Corps of Engineers does not have authority to implement this measure. Once Central Everglades Planning Project is authorized and funds appropriated, U.S. Army Corps of Engineers will revisit this measure in a future Endangered Species Act consultation.
* Actions Outside U.S. Army Corps of Engineers' Authority			
^: Near Term (6-12 months); Mid-Term (2-5 years); Long Term (5+ years)			

7 CONCLUSION

USACE, Jacksonville District acknowledges the probable existence of twenty-nine federally listed threatened and endangered species within the boundaries of ERTP action area. Based on available information, it is evident that the Florida panther, Florida bonneted bat, CSSS, snail kite, wood stork, American alligator, American crocodile, Eastern indigo snake, deltoid spurge, Garber's spurge, Small's milkpea and tiny polygala resides, travels, and/or forages within ERTP action area and could be affected by continued implementation of ERTP and associated reasonable and prudent measures.

Other federally threatened or endangered species that are known to exist or potentially exist within close proximity of the action area, but which would not likely be of concern due to the lack of suitable habitat include Florida manatee, red-cockaded woodpecker, roseate tern, Miami blue butterfly, Schaus swallowtail butterfly, Bartram's hairstreak butterfly, Florida leafwing butterfly, Stock Island tree snail, Okeechobee gourd and Cape Sable thoroughwort.. Federally listed species under the purview of NMFS include the green, hawksbill, Kemp's ridley, leather back and loggerhead sea turtles, along with small-tooth sawfish, elkhorn coral, staghorn coral and Johnson's seagrass. USACE has determined that continued implementation of ERTP and associated reasonable and prudent measures will have no effect on these species.

USACE recognizes that until completion of CERP, there are few opportunities within the current constraints of the C&SF system to completely avoid impacts to listed species. However, the proposed set of reasonable and prudent measures are intended to serve as a transition from ERTP to COP to CERP. This transitional approach allows USACE to take advantage of the best science currently available and to better balance the competing needs of multiple species, as compared to the single-species emphasis embodied in IOP. Although continued implementation of the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the previous operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered snail kite and threatened wood stork.

Continued implementation of ERTP and associated reasonable and prudent measures will provide the ability to better manage WCA-3A for multiple species including the endangered snail kite and threatened wood stork. PMs and ETs contained within ERTP incorporate recommendations of FWS MSTS for WCA-3A which was specifically designed to indentify water depths and stages within WCA-3A to benefit species and the habitats on which they rely. Although an increase in the dry season low is observed under ERTP, real time water management operations, WCA-3A PSC and adaptive management will help to minimize any adverse effects that may be associated with lower stages. However, it is also important to note that ERTP incorporates a 1 in 4 to 1 in 5 year drying event to maintain wet prairie vegetation.

Although a reinitiation trigger has been met, USACE determined that factors other than water management operations may have contributed to the apparent decline in the overall CSSS populations estimate (Virzi and Davis 2013, Slater et al. 2014). In addition, preliminary data from 2015 indicate a total CSSS population estimate of 3,216, which is comparable to CSSS population estimates between 2003 and 2010, and 496 more birds than 2014 CSSS population estimate. This dramatic change between years further underscores the need for a refined methodology for estimating population size. Continuation of water management operations as defined by 2012 ERTP does not represent an irreversible or irretrievable commitment of resources which has the effect of foreclosing the formulation or implementation of any reasonable and prudent measures. USACE is committed to work diligently with FWS to implement reasonable and prudent measures in accordance with 7(a) (2) of the Act.

In conclusion, USACE determined that continuation of operations pursuant to 2012 ERTP will not jeopardize the continued existence of listed species or result in the adverse modification of habitat, nor will it foreclose implementation of any reasonable and prudent measures. USACE has fully complied with 2012 ERTP CSSS protection measures, however, in accordance with the 2012 ERTP BO, USACE concluded that reinitiation of consultation based upon this trigger was required. The USACE requested that as a result of the reinitiation process that: 1) CSSS population estimate incidental take trigger be amended to reflect consideration of the new information that has been provided; 2) if the trigger is amended, that the trigger be established subsequent to ENP quality assessment/quality control review of CSSS range-wide survey data; or 3) this incidental take trigger be removed altogether from an amended BO. USACE formally requested reinitiation of consultation in a letter to FWS dated November 17, 2014.

USACE suggests that FWS focus on identifying vital rates that would have the greatest effect on enhancing CSSS subpopulations in order to prepare the subspecies for future restoration under CERP that will increase water deliveries within ENP to restore historic ridge and slough habitats; as well as changes in available suitable habitat associated with sea level rise. USACE is concerned that any supplementary refinements to 2012 ERTP that result in further restrictions of water deliveries to ENP for protection of CSSS are contrary to CERP restoration goals and would further result in adverse effects to other species within ENP as documented within the 2014 RECOVER System Status Report.

USACE will continue discussions with FWS, NMFS and FWC in the event of operational modifications. This document is being submitted for formal consultation with the FWS and NMFS pursuant to Section 7 of the Endangered Species Act.

8 LITERATURE CITED

Abbott and Nath. 1996. Final Report. Hydrologic Restoration of Southern Golden Gate Estates Conceptual Plan. Big Cypress Basin Board. South Florida Water Management District, Naples, FL.

American Ornithologists Union (AOU). 1983. Checklist of North American birds. Sixth Edition. American Ornithologists Union; Baltimore, MD.

Armentano, T.V., J.P. Sah, M.S. Ross, D.T. Jones, H.C. Cooley and C.S. Smith. 2006. Rapid responses of vegetation to hydrological changes in Taylor Sough, Everglades National Park, Florida, USA. Hydrobiologia 569: 293-309.

Baiser, B., R.L. Boulton, and J.L. Lockwood. 2008. The influence of water depths on nest success of the endangered Cape Sable seaside sparrow in the Florida Everglades. Animal Conservation 11: 190-197.

Balent, K. L., K. H. Fenn, and J. L. Lockwood. 1998. Wet season ecology of the Cape Sable Seaside Sparrow. Chapter 4 *in* Cape Sable Seaside-sparrow annual report: 1998 (S. L. Pimm, Ed.). Unpublished report submitted to Everglades National Park, Homestead.

Bancroft, G. T. 1989. Status and conservation of wading birds in the Everglades. American Birds 43: 1258- 1265.

Bass, O.L., Jr. and K.A. Kushlan. 1982. Status of the Cape Sable seaside sparrow. Report T-672, South Florida Research Center, Everglades National Park, Homestead, FL.

Beissinger, S. R. 1988. Snail Kite. Pages 148-165, *In* R. S. Palmer (Ed.), Handbook of North American Birds. Vol. 4. Yale University Press, New Haven, CT.

Bennetts, R. E., and W. M. Kitchens. 1997. Population dynamics and conservation of Snail Kites in Florida: The importance of spatial and temporal scale. Colonial Waterbirds 20:324-329.

Bennetts, R.E., P.C. Darby, and L.B. Karunaratne. 2006. Foraging patch selection by snail kites in response to vegetation structure and prey abundance and availability. Waterbirds 29(1): 88-94.

Bent, A.C. 1926. Life histories of North American marsh birds. U.S. National Museum Bulletin 135; Washington, D.C.

Borkhataria, R., P. Frederick, and B. Hylton. 2004. Nesting success and productivity of South Florida wood storks in 2004. Unpublished report to the U.S. Fish and Wildlife Service, Jacksonville, FL.

Borkhataria, R., P.C. Frederick, R.A. Hylton, A.L. Bryan, Jr., and J.A. Rodgers. 2006. A preliminary model of Wood Stork (*Mycteria americana*) population dynamics in the Southeastern United States. IV North American Ornithological Conference, Veracruz, Mexico. 4 October 2006.

Borkhataria, R., P.C. Frederick, R.A. Hylton, A.L. Bryan, Jr., and J.A. Rodgers. 2008. A preliminary model of wood stork population dynamics in the southeastern United States. Waterbirds 31 (Special Publication): 42-49.

Boulton, R.L., J.L. Lockwood, and M.J. Davis. 2009a. Recovering small Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) subpopulations: Breeding and dispersal of sparrows in the eastern Everglades 2008. Unpublished report to the United States Fish and Wildlife Service (South Florida Ecological Services, Vero Beach) and the United States National Park Service (Everglades National Park, Homestead).

Boulton, R.L., J.L. Lockwood, M.J., Davis, A. Pedziwilk, K.A., Boadway, J.J.T. Boadway, D. Okines, and S.L. Pimm. 2009b. Endangered Cape Sable seaside sparrow survival. Journal of Wildlife Management 73(4): 530-537.

Browder, J.S. 1978. A modeling study of water, wetlands, and wood storks. Pages 325-346, *In* Wading Birds. A. Sprunt IV, J.C. Ogden, and S. Winckler (Eds). National Audubon Society. Research Report Number 7.

Browder, J.S. 1984. Wood stork feeding areas in southwest Florida. Florida Field Naturalist 12:81-96.

Browder, J.S., C. Littlejohn, and D. Young. 1976. The Florida Study. Center for Wetlands, University of Florida, Gainesville, and Bureau of Comprehensive Planning, Florida Department of Administration, Tallahassee.

Browder, J.S., P.J. Gleason, and D.R. Swift. 1994. Periphyton in the Everglades: spatial variation, environmental correlates, and ecological implications. Pages 379-418, *In* S.M. Davis and J.S. Ogdens (Eds.) Everglades: the Ecosystem and its Restoration. St. Lucie Press, Delray Beach, Florida, USA.

Bryan, A.L. Jr. and M.C. Coulter. 1987. Foraging flight characteristics of wood storks in east-central Georgia, USA. Colonial Waterbirds 10: 157-161.

Bryan, A.L., Jr., M.C. Coulter, and C.J. Pennycuick. 1995. Foraging strategies and energetic costs of foraging flights by breeding wood storks. Condor 97(1):133-140.

Cassey, P., J.L. Lockwood, and K.H. Fenn. 2007. Using long-term occupancy information to inform the management of Cape Sable seaside sparrows in the Everglades. Biological Conservation 139:139-149.

Cattau, C., 2008. Master’s Thesis. University of Florida, Gainesville, Florida, USA.

Cattau, C., W. Kitchens, B., Reichert, A., Bowling, A., Hotaling, C., Zweig, J., Olbert, K., Pias, and J. Martin. 2008. Demographic, movement and habitat studies of the endangered snail kite in response to operational plans in water conservation area 3A. Annual Report 2008. Unpublished report to the U.S. Army Corps of Engineers Jacksonville, FL.

Cattau, C., W. Kitchens, B., Reichert, J., Olbert, K., Pias, J., Martin, and C. Zweig. 2009. Demographic, movement and habitat studies of the endangered snail kite in response to operational plans in water conservation area 3A. Annual Report 2009. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, FL.

Cherkiss, M.C., 1999. Status and Distribution of the American Crocodile (*Crocodylus acutus*) in Southeastern Florida. Master's Thesis, University of Florida. Gainesville.

Code of Federal Regulations [CFR] 50 Parts 1 to 199; 10-01-00

Cone, W.C. and J.V. Hall. 1970. Wood ibis found nesting in Okeefenokee Refuge. Oriole 35:14.

Cook, M.I. and E. M. Call. 2005. South Florida Wading Bird Report, Volume 10. Unpublished Report, South Florida Water Management District. September 2005.

Coulter, M.C. 1987. Foraging and breeding ecology of wood storks in East-Central Georgia. Pages 21-27, *In* R.R. Odom, K.A. Riddleberger, and J.C. Ozier (eds.) Proceedings of the Third Southeastern Nongame and Endangered Wildlife Symposium. Georgia Department of Natural Resources, Game and Fish Division.

Coulter, M.C. and A.L. Bryan, Jr. 1993. Foraging ecology of wood storks (*Mycteria americana*) in east central Georgia: Characteristics of foraging sites. Colonial Waterbirds 16:59 70.

Coulter, M.C., J.A. Rodgers, J.C. Ogden, and F.C. Depkin. 1999. Wood stork (*Mycteria americana*). *In* The Birds of North America, No. 409 9A. Poole and F. Gill, (Eds). The Birds of North America, Inc., Philadelphia, PA.

Crozier, G.E. and M.I. Cook. 2004. South Florida Wading Bird Report, Volume 10. Unpublished report, South Florida Water Management District. November 2004.

Curnutt, J.L., and S.L. Pimm. 1993. Status and ecology of the Cape Sable seaside sparrow. Unpublished report prepared for the U.S. Fish and Wildlife Service and the National Park Service; Vero Beach, Florida.

Curnutt, J.L., A.L. Mayer, T.M. Brooks, L., Manne, O.L., Bass Jr., D.M. Fleming, D.M., M.P. Nott, and S.L. Pimm, 1998. Population dynamics of the endangered Cape Sable seaside sparrow. Animal Conservation 1, 11–21.

Dahl, T.E. 1990. Wetlands losses in the United States 1780s to 1980s. U.S. Department of the Interior, Fish and Wildlife Service; Washington, D.C.

Darby, P.C., 1998. Florida apple snail (*Pomacea paludosa* Say) life history in the context of a hydrologically fluctuating environment. Ph.D. Dissertation. University of Florida, Gainesville, Florida, USA.

Darby, P.C., J. D. Croop, R. E. Bennetts, P. L. Valentine-Darby and W. M. Kitchens. 1999. **A** comparison of sampling techniques for quantifying abundance of the Florida apple snail (*Pomacea paludosa*, SAY). Journal of Molluscan Studies 65:195-208.

Darby, P.C., R.E. Bennetts, S. Miller, and H.F. Percival. 2002. Movements of Florida apple snails in relation to water levels and drying events. Wetlands 22(3): 489-498.

Darby, P.C., R.E. Bennetts, and H. F. Percival. 2008. Dry down impacts on apple snail (*Pomacea paludosa*) demography: implications for wetland water management. Wetlands 28(1): 204-214.

Darby, P.C., I. Fujisaki, and D.J. Mellow. 2012. The effects of prey density on capture times and foraging bout success of course-hunting adult snail kites. The Condor 114(4): 755-763.

Davis, S.M., L.H. Gunderson, W.A. Park, J.R. Richardson, and J.E. Mattson. 1997. Landscape dimension, composition, and functioning in a changing Everglades ecosystem. Pages 419-444. *In* S.M. Davis and J.C. Ogden (Eds). Everglades: the Ecosystem and its Restoration. St. Lucie Press, Delray Beach, Florida, USA.

Davis, S.M. and J.C. Ogden, 1997. Everglades: the Ecosystem and its Restoration. St. Lucie Press, Delray Beach, Florida, USA

Dean, T. F. and J.L. Morrison, 1998. Non-breeding season ecology of the Cape Sable seaside sparrow *(Ammodramus maritimus mirabilis}:* 1997-1998 field season final report. Unpublished report submitted to the U.S. Fish and Wildlife Service.

Dean, T. F. and J.L. Morrison, 2001. Non-breeding season ecology of the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). Final Report. Unpublished report to the Fish and Wildlife Service, Vero Beach, Florida, USA

Duellman, W.E., and A. Schwartz. 1958. Amphibians and reptiles of southern Florida. Bulletin Florida State Museum, Biological Science 3:181-324.

Dusi, J.L. and R.T. Dusi. 1968. Evidence for the breeding of the wood stork in Alabama. Alabama Birds 16:14 16.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1992. Birds in jeopardy. Stanford University Press; Stanford, California.

Everglades National Park. 2015. Bartram's hairstreak butterfly. http://www.nps.gov/ever/learn/nature/bartrams.htm

Ferrer, J.R., G. Perera, and M. Yong, 1990. Life tables of *Pomacea paludosa* (Say) in natural conditions. Florida Scientist 53 (supplement): 15.

Fertl, D., A.J. Schiro, G.T. Regan, C.A. Beck, N.M. Adimey, L. Price-May, A. Amos, G.A.J, Worthy, and R. Crossland, 2005. Manatee occurrence in the Northern Gulf of Mexico, west of Florida. Gulf and Caribbean Research 17:69-74.

Fleming, D.M., W.F. Wolff, and D.L. DeAngelis. 1994. Importance of landscape heterogeneity to wood storks in Florida Everglades. Environmental Management 18(5): 743-757.

Fletcher, R. J., A. Revell, B.E. Reichert, W.M. Kitchens, J.D. Dixon, and J.D. Austin. 2013. Network modularity reveals critical scales for connectivity in ecology and evolution. Nature Communications 4:2572.

Fletcher, R., E. Robertson, B. Reichert, C. Cattau, R. Wilcox, C. Zweig, B. Jeffery, J. Olbert, K. Pias, and W. Kitchens. 2015. Snail kite demography: 5-year report. Prepared for U.S. Army Corps of Engineers, Jacksonville, Florida.

Florida Power and Light. 1989. The West Indian Manatee In Florida. Written by Victoria Brook Van Meter for Florida Power & Light Company. Miami, Florida.

Frederick, P., 2009. Monitoring of wood stork and wading bird reproduction in WCAs 1, 2, & 3 of the Everglades. Annual Report 2009. Unpublished report to the U.S. Army Corps of Engineers.

Frederick, P. 2010. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2009. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Frederick, P. 2011. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2010. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Frederick, P. 2012. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2011. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Frederick, P. 2013. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2012. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Frederick, P. 2014. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2013. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Frederick, P. 2015. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2014. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Frederick, P.C. and J.C. Ogden, 2001. Pulsed breeding of long-legged wading birds and the importance of infrequent severe drought conditions in the Florida Everglades. Wetlands 1(4): 484-491.

Frederick, P., J. Simon, and R.A. Borkhataria. 2009. Monitoring of wading bird reproduction in WCAs 1,2 and 3 of the Everglades. Annual Report 2008. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida.

Gawlik, D.E., 2002. The effects of prey availability on the numerical response of wading birds. Ecological Monographs 72(3): 329-346.

Gawlik, D.E. and G.E. Crozier, 2007. A test of cues affecting habitat selection by wading birds. The Auk 124(3): 1075-1082.

Gawlik, D. E., G. Crozier, K. H. Tarboton. 2004. Wading bird habitat suitability index. Pages 111-127, *In* K. C. Tarboton, M. M. Irizarry-Ortiz, D. P. Loucks, S. M. Davis, and J. T. Obeysekera. Habitat suitability indices for evaluation water management alternatives. Technical Report, South Florida Water Management District, West Palm Beach, FL.

Gunderson, L. H., C.S. Holling, G. Peterson, G. and L. Pritchard. 1997. Resilience in ecosystems, institutions and societies. Beijer Discussion Paper Number 92, Beijer International Institute for Ecological Economics, Stockholm, Sweden.

Hanning, G.W., 1979. Aspects of reproduction in *Pomacea paludosa* (Mesogastropoda: Pilidae). M.S. Thesis. Florida State University, Tallahassee, Florida, USA.

Hartman, D.S., 1979. Ecology and Behavior of the Manatee *Trichechus manatus*) in Florida. American Society of Mammalogists, Special Publication No. 5. Pittsburgh, PA. 154 pp.

Hefner, J. M., B. O. Wilen, T. E. Dahl, and W. E. Frayer. 1994. Southeast wetlands; Status and trends, mid 1970s to mid 1980s. U.S. Department of the Interior, Fish and Wildlife Service, Atlanta, GA.

Herring, G., and D. E. Gawlik. 2007. Multiple nest-tending behavior in an adult female White Ibis. Waterbirds 30:150-151.

Holling, C. S., L. H. Gunderson, and C. J. Walters. 1994. The structure and dynamics of the Everglades system: guidelines for ecosystem restoration. Pages 741-756, *In* S. M. Davis and

J. C. Ogden, editors. Everglades: the ecosystem and its restoration. St. Lucie Press, Delray Beach, Florida, USA.,

Howell, A.H. 1932. Florida bird life. Coward McCann; New York, NY.

Hylton, R.A., P.C. Frederick, T.E. De La Fuente, and M.G. Spalding. 2006. Effects of nestling health on postfledging survival of wood storks. Condor 108:97-106.

Jordan, A.R., D.M. Mills, G. Ewing and J.M. Lyle. 1998. Assessment of inshore habitats around Tasmania for life-history stages of commercial finfish species, Published by Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

Kahl, M.P., Jr. 1964. Food ecology of the wood stork (*Mycteria americana*) in Florida. Ecological Monographs 34:97 117.

Kautz, R. J., R. Kawula, T. Hoctor, J. Comiskey, D. Jansen, D. Jennings, J. Kasbohm, F Mazzotti, R. McBride, L. Richardson, and K. Root. 2006. How much is enough? Landscape-scale conservation for the Florida panther. Biological Conservation 130:118–133.

Karunaratne, L.B., P.C. Darby and R.E. Bennetts. 2006. The effects of wetland habitat structure on Florida apple snail density. Wetlands 26(4): 1143-1150.

Kitchens, W.M., R.E. Bennetts, and D.L. DeAngelis. 2002. Linkages between the snail kite population and wetland dynamics in a highly fragmented South Florida hydroscape. Pages 183 - 203 *In* Porter, J.W. and K.G. Porter, (Eds). Linkages between ecosystems: the south Florida hydroscape. CRC/St. Lucie Press, Delray Beach, Florida, USA.

Kushlan, J. A. 1975. Population changes of the apple snail, *Pomacea paludosa*, in the southern Everglades. Nautilus 89:21-23.

Kushlan, J.A. 1979. Prey choice by tactile foraging wading birds. Proceedings of the Colonial Waterbird Group 3:133 142.

Kushlan, J.A. and P.C. Frohring. 1986. The history of the southern Florida wood stork population. Wilson Bulletin 98(3):368-386.

Kushlan, J.A. and F.J. Mazzotti. 1989. Historic and present distribution American crocodile in Florida. Journal of Herpetology 23(1):1-7

Kushlan, J. and O. Bass, Jr. 1983. Habitat use and distribution of the Cape Sable seaside sparrow. Pp. 139-146 in The seaside sparrow: its biology and management. (T. Quay, J. Funderburg, Jr., D. Lee, E. Potter and C. Robbins, Eds.). Occasional Papers of the North Carolina Biological Survey 1983-5, Raleigh, North Carolina.

Kushlan, J.A., J.C. Ogden, and J.L. Tilmant. 1975. Relation of water level and fish availability to wood stork reproduction in the southern Everglades, Florida. U.S. Geological Survey Open File Rep. 75-434.

Kushlan, J.A., O. L. Bass, Jr., L. L. Loope, W. B. Robertson, Jr., P. C. Rosendahl, and D. L. Taylor. 1982. Cape Sable Sparrow management plan. National Park Service Report M-660, Everglades National Park.

Lefebvre, L.W., J. P. Reid , W. J. Kenworthy, and J. A. Powell, 2000. Characterizing manatee habitat use and seagrass grazing in Florida and Puerto Rico: implications for conservation and management. Pacific Conservation Biology 5: 289–298.

Lockwood, J.L., K. Fenn, J. Curnutt, D. Rosenthal, K.L. Balent, and A.L. Mayer. 1997. Life history of the endangered Cape Sable seaside sparrow. Wilson Bulletin 109: 720-731.

Lockwood, J.L., K. Fenn, K.H. Caudill, D. Okines, O.L. Bass Jr., J.R. Duncan, and S.L. Pimm. 2001. The implications of Cape Sable seaside sparrow demography for Everglades restoration. Animal Conservation 4: 275-281.

Lockwood, J.L., M.S. Ross and J.P. Sah. 2003. Smoke on the water: the interplay of fire and water flow on Everglades restoration. Frontiers in Ecology and the Environment 1(9): 462-468.

Lockwood, J.L., B. Baiser, R.L. Boulton, and M.J. Davis, 2006. Detailed study of Cape Sable seaside sparrow nest success and causes of nest failure. 2006 Annual Report. US Fish and Wildlife Service, Vero Beach, Florida, USA

Lockwood, J.L., R.L. Boulton, B. Baiser, M.J. Davis and D.A. La Puma, 2008. Detailed study of Cape Sable seaside sparrow nest success and causes of nest failure: Recovering small populations of Cape Sable seaside sparrows: 2007 Annual Report. Unpublished report to the USFWS, Vero Beach, FL and Everglades National Park, Homestead, Florida, USA

Loftus, W.F. and A. Eklund. 1994. Long-term dynamics of an Everglades small-fish assemblage Pp. 461-484 in Everglades: The ecosystem and its restoration, Davis, S.M. and Ogden, J. C. (Eds.) St. Lucie Press, Delray, Florida

MacKenzie, D.I., J.D. Nicholas, G.B. Lachman, S. Droege, J.A. Royle, and C.A. Langtimm, 2002. Estimating occupancy rates when detection probabilities are less than one. Ecology 83: 2248-2255.

Marks, G.E. and C.S. Marks. 2008. Status of the Florida bonneted bat (*Eumops floridanus*). Final report submitted by the Florida Bat Conservancy for the U.S. Fish and Wildlife Service under Grant Agreement 401815G192 Florida Bat Conservancy. Bay Pines, Florida.

Martin, J. 2007. Population Ecology and Conservation of the Snail Kite. A Dissertation. Graduate School, University of Florida.

Martin, J., J. D. Nichols, J. E. Hines, and W. M. Kitchens. 2006a. Multiscale patterns of movement in fragmented landscapes and consequences on demography of the snail kite in Florida. Journal of Animal Ecology 75(2): 527-539.

Martin, J., W. Kitchens, C. Cattau, A. Bowling, M. Conners, D. Huser, and E. Powers. 2006b. Demographic, movement and habitat studies of the endangered snail kite in response to operational plans in water conservation area 3A. Annual Report 2005. Unpublished Report to the U.S. Army Corps of Engineers, Jacksonville, Florida, USA.

Martin, J., W. M. Kitchens, C. Cattau, A. Bowling, S. Stocco, E. Powers, C. Zweig, A. Hotaling, Z. Welch, H. Waddle, A. Paredes. 2007. Snail Kite Demography Annual Progress Report 2006c. Florida Cooperative Fish and Wildlife Research Unit and University of Florida, Gainesville. Unpublished report to the U.S. Army Corps of Engineers, Jacksonville, Florida, USA

Martin J., W.M. Kitchens. C.E. Cattau, C.E. and M.K. Oli, 2008. Relative importance of natural disturbances and habitat degradation on snail kite population dynamics. ESR 6, 25-39.

Mazzotti, F.J., M.S. Cherkiss, G.S. Cook, and E. McKercher. 2002. Status and conservation of the American crocodile in Florida: Recovering and endangered species while restoring an endangered ecosystem. Draft Final report to Everglades National Park. Homestead, Florida.

McVoy, C., W.P. Said, J. Obeysekera, J. VanArman, and T.W. Dreschel. 2011. Landscapes and Hydrology of the Predrainage Everglades. South Florida Water Management District, Gainesville, Florida: University Press of Florida.

Meyer, K.D. and P.C. Frederick. 2004. Survey of Florida's wood stork (*Mycteria americana*) nesting colonies, 2004. Unpublished report to the U.S. Fish and Wildlife Service, Jacksonville, FL.

Mooij, W. M., R. E. Bennetts, W. M. Kitchens and D. L. DeAngelis. 2002. Exploring the effect of drought extent and interval on the Florida snail kite: interplay between spatial and temporal scales. Ecological Modeling 149: 25-39.

NatureServ. 2009. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JB

Nicholson, D. J. 1928. Nesting habits of Seaside Sparrows in Florida. Wilson Bulletin 40:225-237.

Nott, M.P., O.L. Bass Jr., D.M. Fleming, S.E. Killefer, N. Fraley, L. Manne, J.L. Curnutt, T.M. Brooks, R. Powell, and S.L. Pimm, 1998. Water levels, rapid vegetational change, and the endangered Cape Sable seaside sparrow. Animal Conservation 1, 23–32.

Oberholser, H.C. 1938. The bird life of Louisiana. Louisiana Department of Conservation, Bulletin 28.

Oberholser, H.C. and E.B. Kincaid, Jr. 1974. The bird life of Texas. University of Texas Press; Austin, TX.

Odum, H.T., 1957. Primary Production Measurements in Eleven Florida Springs and a Marine Turtle-Grass Community. Limnology and Oceanography 2 (2): 85-97

Ogden, J.C., 1991. Nesting by wood storks in natural, altered, and artificial wetlands in central and northern Florida. Colonial Waterbirds 14:39 45.

Ogden, J.C. 1994. A comparison of wading bird nesting colony dynamics (1931–1946 and 1974–1989) as an indication of ecosystem conditions in the southern Everglades. *In* S. M. Davis and J. C. Ogden (eds.) Everglades, the Ecosystem and its Restoration. St. Lucie Press, Delray Beach, FL, USA, p. 533–570.

Ogden, J.C. and S.A. Nesbitt. 1979. Recent wood stork population trends in the United States. Wilson Bulletin. 91(4): 512-523.

Ogden, J.C., J.A. Kushlan, and J.T. Tilmant. 1976. Prey selectivity by the wood stork. Condor 78(3):324 330.

Ogden, J.C., J.A. Kushlan, and J.T. Tilmant. 1978. The food habits and nesting success of wood storks in Everglades National Park in 1974. U.S. Department of the Interior, National Park Service, Natural Resources Report No. 16.

Palmer, R.S., 1962. Handbook of North American birds, Volume 1, Loons through Flamingos. Yale University Press; New Haven, CT.

Patterson, K., and R. Finck. 1999. Tree Islands of the WCA3 aerial photointerpretation and trend analysis project summary report. St. Petersburg, Florida: Geonex Corporation. Report to the South Florida Water Management District.

Pias, K.E., Z.C. Welch, and W.M. Kitchens. 2012. An artificial perch to help snail kites handle an exotic apple snail. Waterbirds 35(2): 347-351.

Pimm, S.L., J.L. Lockwood, C.N. Jenkins, J.L. Curnutt, M.P. Nott, R.D. Powell, and O.L. Bass Jr., 2002. Sparrow in the grass: a report on the first ten years of research on the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). Report to Everglades National Park, Homestead, Florida.

Post, W. 2007. Practical ways of saving seaside sparrows. Presentation to the Sustainable Ecosystems Institute Avian Ecology Forum. August 13-15, 2007, Florida International University, Miami, Florida, USA.

Rand, A.L. 1956. Foot stirring as a feeding habit of wood ibis and other birds. American Midland Naturalist 55:96 100.

Rathbun, G. B., J. A. Powell and J. P. Reid. 1983. Movements of manatees (*Trichechus manatus*) using power plant effluents in southern Florida. Final Rept., Florida Power and Light Co., Purchase Order No. 88798-87154. 12 pp.

RECOVER. 2009. 2009 System status report. Restoration Coordination and Verification Program c/o United States Army Corps of Engineers, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.

RECOVER. 2014. 2014 System status report. Restoration Coordination and Verification Program c/o United States Army Corps of Engineers, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.

Rehage, J. S. and J. C. Trexler. 2006. Assessing the net effect of anthropogenic disturbance on aquatic communities in wetlands: community structure relative to distance from canals. Hydrobiologia 569: 359-373.

Reichert, B.E. 2014. Spatial structure in demography and movements of the endangered snail kite: revealing multi-scale patterns and their implications for conservation. Ph.D. Dissertation, University of Florida, Gainesville, Florida, USA.

Rich, E. 1990. Observations of feeding by *Pomacea paludosa*. Florida Scientist 53 (supplement):13.

Rodgers, J.A., Jr., 1990. Breeding chronology and clutch information for the wood stork from museum collections. Journal of Field Ornithology 61(1):47 53.

Rodgers, J.A., Jr. and S.T. Schwikert, 1997. Buffer zone differences to protect foraging and loafing waterbirds from disturbance by airboats in Florida. Waterbirds 26(4): 437-44

Rodgers, J.A., Jr., A.S. Wenner, and S.T. Schwikert, 1987. Population dynamics of wood storks in north and central Florida. Colonial Waterbirds 10:151 156.

Ross, M.S., J.P. Sah, J.R. Snyder, P.L. Ruiz, D.T. Jones, H. Cooley, and R. Travieso and 2003. Effect of hydrological restoration on the habitat of the Cape Sable seaside sparrow. Annual Report of 2002-2003. Report to Everglades National Park, Homestead, FL.

Ross, M.S., J.P. Sah, J.R. Snyder, P.L. Ruiz, D.T. Jones, H. Cooley, R. Travieso and S. Robinson. 2004. Effect of hydrological restoration on the habitat of the Cape Sable seaside sparrow. Annual Report of 2003-2004. Report to Everglades National Park, Homestead, FL.

Ross, M.S., J.P. Sah, J.R. Snyder, P.L. Ruiz, D.T. Jones, H. Cooley, R. Travieso and D. Hagayari. 2006. Effect of hydrology restoration on the habitat of the Cape Sable seaside sparrow. Annual Report of 2004-2005. Report to Everglades National Park, Homestead, FL.

Sah, J.P., M.S. Ross, J.R. Snyder, P.L. Ruiz, D.T. Jones, R. Travieso, S. Stoffella, N. Timilsina, H.C. Cooley and B. Barrios. 2007. Effect of hydrological restoration on the habitat of the Cape Sable seaside sparrow. Annual Report of 2005-2006. Report to Everglades National Park, Homestead, FL.

Sah, J.P., M.S. Ross, J.R. Snyder, P.L. Ruiz, S. Stoffella, M. Kline, B. Shamblin, E. Hanan, D. Ogurcak and B. Barrios. 2008. Effect of hydrological restoration on the habitat of the Cape Sable seaside sparrow. Annual Report of 2006-2007. Report to Everglades National Park, Homestead, FL.

Sah, J.P., M.S. Ross, J.R. Snyder, P.L. Ruiz, S. Stoffella, M. Kline, B. Shamblin, E. Hanan, L. Lopez and T.J. Hilton. 2009. Effect of hydrologic restoration on the habitat of the Cape Sable seaside sparrow. Final Report 2008. Report to U.S. Army Corps of Engineers, Jacksonville, FL.

Schaefer, J. and J. Junkin. December, 1990. University of Florida, Florida Cooperative Extension Service. Publication SS-WIS-24: The Eastern Indigo Snake: A Threatened Species. Gainesville, Florida.

Sharfstein, B. and A. D. Steinman, 2001. Growth and survival of the Florida apple snail (*Pomacea paludosa*) fed 3 naturally occurring macrophyte assemblages. Journal of the North American Benthological Society: 20(1): 84–95.

Sklar, F. and A. van der Valk, eds. 2002. Tree islands of the Everglades: an overview. Pages. 1-18 *in* Tree Islands of the Everglades. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Small, J.K. 1922. Wild pumpkins. Journal New York Botanical Garden 23:19-23

South Florida Water Management District. 2004. South Florida Wading Bird Report. M.I. Cook and M. Kobza (eds).

South Florida Water Management District. 2008. South Florida Wading Bird Report. M.I. Cook and M. Kobza (eds).

South Florida Water Management District. 2009. South Florida Wading Bird Report. M.I. Cook and M. Kobza (eds).

Sklar, F. H., C. McVoy, R. VanZee, G.E. Gawlik, K. Tarboton, D. Rudnick, S. Miao, and T. Armentano, 2002. The effects of altered hydrology on the ecology of the Everglades. Pages 39-82, *In* The Everglades, Florida Bay, and Coral Reefs of the Florida Keys: An ecosystem sourcebook. Porter, J.W. and K.G. porter (eds.). CRC Press, Boca Raton, Florida, USA.

Slater, G, M.J. Davis, and T. Virzi. 2014. Recovery of the endangered Cape Sable seaside sparrow in Everglades National Park: monitoring and setting priorities. Final Report to the United States National Park Service (Everglades National Park, Homestead, Florida).

Snyder, N. F. R., S. R. Beissinger, and R. Chandler. 1989. Reproduction and demography of the Florida Everglade (Snail) Kite. Condor 91:300-316.

Sprunt, A., Jr., 1968. Florida Bird Life. Coward-McCann, Inc., New York.

Steiner, T.M., O.L. Bass, Jr., and J.A. Kushlan. 1983. Status of the eastern indigo snake in southern Florida National Parks and vicinity. South Florida Research Center Report SFRC-83/01, Everglades National Park; Homestead, Florida.

Stevenson, H.M. and B.H. Anderson. 1994. The birdlife of Florida. University Press of Florida; Gainesville, Florida.

Stith, B.M., D.H. Slone, and J.P. Reid. 2006. Review and synthesis of manatee data in Everglades National Park. Final Report for USGS/ENP Agreement # IA F5297-04-0119, November 2006. 110 pp.

Sustainable Ecosystems Institute, 2007. Everglades Multi-Species Avian Ecology and Restoration Review. Sustainable Ecosystems Institute, Portland Oregon.

Sykes, P.W., Jr. 1987a. The feeding habits of the Snail Kite in Florida, USA. Colonial Waterbirds 10:84-92.

Sykes, P.W. 1987b. Some aspects of the breeding biology of the Snail kite. Journal of Field Ornithology. 58:171-189.

Sykes, P .W., J. A. Rodgers, and R. E. Bennetts. 1995. Snail Kite (*Rostrhamus sociabilis*). In A. Poole and F. Gill (eds.) The Birds of North America, No. 171. The Academy of Natural Sciences, Philadelphia and the American Ornithologists' Union, Washington, D.C.

Takekawa, J. E., and S. R. Beissenger. 1989. Cyclic drought, dispersal, and conservation of the Snail Kite in Florida: Lessons in critical habitat. Conservation Biology 3:302-311.

Therrien, M.P., P.C. Darby, and I. Fujisaki. 2014. Florida apple snail (*Pomacea paludosa*) monitoring. Final Report 20014. Report to U.S. Army Corps of Engineers, Jacksonville, Florida

Trexler, J.C., W.F. Loftus, F. Jordan, J.H. Chick, K.L. Kandl, T.C. McElroy, and O.L. Bass. 2002. Ecological scale and its implications for freshwater fishes in the Florida Everglades. Pages 153-182, In The Everglades, Florida Bay, and Coral Reefs of the Florida Keys: An ecosystem sourcebook (J. W. Porter and K. G. Porter, eds.). CRC Press, Boca Raton, FL.

Trost, C.H. 1968. Dusky seaside sparrow. Pages 859-868 *in* A.C. Bent, O.L. Austin, Jr., eds. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. National Museum Bulletin; Washington, D.C.

Troxler, T.G., and D.L. Childers. 2010. Biogeochemical contributions of tree islands to Everglades wetland landscape nitrogen cycling during seasonal inundation. Ecosystems 13:75-89.

Turner, A.W., J.C. Trexler, C.F. Jordan, S.J. Slack, P. Geddes, J.H. Chick, and W.F. Loftus. 1999. Targeting ecosystem features for conservation: standing crops in the Everglades. Conservation Biology 13(4):898-911.

Turner, R. L. 1996. Use of stems of emergent vegetation for oviposition by the Florida apple snail (*Pomacea paludosa*), and implications for marsh management. Florida Scientist 59:34–49.

U.S. Army Corps of Engineers. 1995. Environmental Assessment and Finding of No Significant Fact, Test Iteration 7, Experimental Program of Water Deliveries to Everglades National Park, Central and Southern Florida Project for Flood Control and Other Purposes. Jacksonville District, Jacksonville, Florida, USA.

U.S. Army Corps of Engineers. 1999a. Central and Southern Florida Project Comprehensive Review Study: Final Integrated Feasibility Report and Programmatic Environmental Impact Statement. Jacksonville District, Jacksonville, Florida, USA.

U.S. Army Corps of Engineers. 1999b. 1998 Emergency Deviation From Test 7 of the Environmental Program of Water Deliveries to Everglades National Park to Protect the Cape Sable Seaside Sparrow, Central and Southern Florida Project For Flood Control and Other Purposes. Final Environmental Assessment. Jacksonville District, Jacksonville, Florida, USA.

U.S. Army Corps of Engineers. 2000. Final Environmental Assessment, Central and Southern Florida Project for Flood Control and Other Purposes, Interim Structural and Operational Plan (ISOP), Emergency Deviation from Test 7 of the Experimental Program of Water Deliveries to Everglades National Park for Protection of the Cape Sable Seaside Sparrow, Dade County, Florida. Jacksonville District, Jacksonville, Florida, USA.

U.S. Army Corps of Engineers. 2010. Water Resources Engineering Branch Position Statement on WCA-3A Regulation Schedule. Memorandum for SAJ Levee Safety Officer (Steve Duba). Jacksonville District, Jacksonville, Florida, USA.

U.S. Army Corps of Engineers. 2012. Everglades Restoration Transition Plan Final Environmental Impact Statement, Dade County, Florida. Jacksonville District, Jacksonville, Florida, USA.

U.S. Fish and Wildlife Service. 2001. Final Coordination Act Report for the Interim Operating Plan for the Protection of the Cape Sable Seaside Sparrow. Vero Beach, Florida, USA.

U.S. Fish and Wildlife Service. 1983. Cape Sable seaside sparrow recovery plan. U.S. Fish and Wildlife Service; Atlanta, Georgia, USA.

U.S. Fish and Wildlife Service. 1996-2004. Annual narrative report for A.R.M. Loxahatchee National Wildlife Refuge, Boynton Beach, Florida, USA.

U.S. Fish and Wildlife Service. 1997. Revised recovery plan for the U.S. breeding population of the wood stork. U.S. Fish and Wildlife Service; Atlanta, Georgia, USA.

U.S. Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan. Southeast Region, Atlanta, Georgia, USA.

U.S. Fish and Wildlife Service. 2006. Interim Operational Plan Biological Opinion. Prepared by the South Florida Ecological Services Office, Vero Beach, Florida, USA.

U.S. Fish and Wildlife Service. 2010. Final Biological Opinion for the U.S. Army Corps of Engineers, Everglades Restoration Transition Plan. Vero Beach, Florida, USA.

U.S. Fish and Wildlife Service. 2010. Eco-recommendations for the multi-species schedule. Presentation to the ERTP Team. January 15, 2010. Vero Beach, Florida, USA.

U.S. Fish and Wildlife Service. 2013a. Central Everglades Planning Project Biological Opinion. Prepared by the South Florida Ecological Services Office, Vero Beach, Florida, USA.

U.S. Fish and Wildlife Service. 2013b. Federal Register Volume 78, Number 158, August 15, 2013. Prepared by the South Florida Ecological Services Office, Vero Beach, Florida, USA.

Van der Walk, A.G., L. Squires, and C.H. Welling. 1994. Assessing the impacts of an increase in water levels on wetland vegetation. Ecological Applications 4: 525-533.

Virzi, T. 2009. Recovering small Cape Sable seaside sparrow populations. Cape Sable Seaside Sparrow Fire Symposium. Everglades National Park, December 8, 2009.

Virzi, T., and M.J. Davis. 2013. Recovering small Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) subpopulations: breeding and dispersal of sparrows in the Everglades. Final Report to the United States National Park Service ((Everglades National Park, Homestead, Florida).

Virzi, T., J.L. Lockwood, R.L. Boulton and M.J. Davis. 2009. Recovering small Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) subpopulations: Breeding and dispersal of sparrows in the Everglades. Report to: U.S. Fish and Wildlife Service (Vero Beach, Florida) and the U.S. National Park Service (Everglades National Park, Homestead, Florida).

Wayne, A.T. 1910. Birds of South Carolina. Contributions to the Charleston Museum No.1.

Walters, C., L. Gunderson and C. S. Holling. 1992. Experimental policies for water management in the Everglades. Ecological Applications 2:189-202.

Walters, J.R., S.R. Beissinger, J.W. Fitzpatrick, R. Greenberg, J.D. Nicholas, H.R. Pulliam, H.R., and D.W. Winkler. 2000. The AOU conservation committee review of the biology, status, and management of Cape Sable seaside sparrow: final report. The Auk 117(4): 1093-1115.

Werner, H., 1975. The biology of the Cape Sable seaside sparrow. Report to US Fish and Wildlife Service. Everglades National Park, Homestead, FL.

Werner, H. W. 1978. Cape Sable Seaside Sparrow. Pages 19-20 *in* Rare and endangered biota or Florida, Vol. 2: Birds (H. w. Kale, Ed.). University Presses of Florida, Gainesville.

Wetzel, R.G. (Ed). 1983. Periphyton of Freshwater Ecosystems. W. Junk Publishers, Boston, Massachusetts, USA.

Wetzel, P.R., A.G. van der Valk, S. Newman, C.A. Coronado, T.G. Troxler-Gann, D.L. Childers, W.H. Orem, F.H. Sklar. 2009. Heterogeneity of phosphorous distribution in a patterned landscape, the Florida Everglades. Plant Ecology 200:69-82.

Wetzel, P.R., F.H. Sklar, C.A. Coronado, T.G. Troxler, S.L. Krupa, P.L. Sullivan, S. Ewe and S. Newman. 2011. Biogeochemical processes on tree islands in the Greater Everglades: Initiating a new paradigm. Critical Reviews in Environment and Technology 41:670-701.

Wood, J.M. and G.W. Tanner, 1990. Graminoid community composition and structure within four everglades management areas. Wetlands 10(2): 127-149.

Woolfenden, G.E. 1956. Comparative breeding behavior of *Ammospiza candacuta* and *A. maritima.* University of Kansas Publishing, Museum of Natural History; Lawrence, Kansas.

Woolfenden, G.E. 1968. Northern seaside sparrow. Pages 153-162 *in* A.C. Bent, O.L. Austin, Jr., eds. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. National Museum Bulletin; Washington, D.C.

Zweig, C.L., 2008. Effects of landscape gradients on wetland vegetation. Ph.D. Dissertation. University of Florida, Gainesville, Florida, USA.

Zweig, C.L. and W.M. Kitchens, 2008. Effects of landscape gradients on wetland vegetation communities: information for large-scale restoration. 2008. Wetlands 28(4): 1086-1096.

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